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Brooks (A. R.). **Identification of Bombyliid Parasites and Hyperparasites of Phalaenidae of the Prairie Provinces of Canada, with Descriptions of six other Bombyliid Pupae (Diptera).**—*Canad. Ent.* **84** no. 12 pp. 357–373, 46 figs., 2 refs. Ottawa, 1952.

A list is given of four species of *Poecilanthrax*, four of *Villa* and four of *Hemipenthes* reared from cutworms in the Prairie Provinces of Canada, with locality and host records. These Bombyliids were responsible for only 2–5 per cent. of the total parasitism observed, and no detailed information on their bionomics is available. The host species all oviposit in August–September, but whereas some of them overwinter as eggs and are in the larval stage in May–June, others overwinter as larvae; all pupate during July–August. The parasite adults are active from the latter half of July until September. The larvae appear to attack the host larvae in May–June and may therefore overwinter in the egg stage, either in the soil or on old vegetation; no larvae were found in the soil or externally on cutworms. Only one larval skin, which appeared to be that of the mature larva, was found in each host. *Hemipenthes* spp. are generally considered to be hyperparasites, but only one larval skin was found in the primary parasite and none in the cutworm host. Keys are given to the pupae of all 12 Bombyliids, the larvae of 11 and the adults of eight, with general descriptions of the larvae and pupae.

Descriptions are appended of the pupae of six further Bombyliids that are associated with insects other than cutworms in Canada; those of four of them are described for the first time.

Mashhood Alam (S.). **A Contribution to the Biology of *Stenobracon deesae* Cameron (Braconidae, Hymenoptera), and the Anatomy of its pre-imaginal Stages.**—*Z. Parasitenk.* **15** pt. 3 pp. 159–182, 17 figs., refs. Berlin, 1952.

The author describes the immature stages and the internal anatomy of the larvae of *Glyptomorpha* (*Stenobracon*) *deesae* (Cam.) and gives an account of field and laboratory observations in Uttar Pradesh on the bionomics of this Braconid, which is widely distributed throughout India as an ectoparasite of the larvae of Lepidopterous borers of sugar-cane and sorghum. The species attacked are *Scirpophaga nivella* (F.), *S. monostigma* Zell., *Chilotraea infuscatella* (Sn.) (*Argyria sticticraspis* Hmps.), *C.* (*Diatraea*) *auricilia* (Dudgn.), *Emmalocera depressella* (Swinh.) [*cf. R.A.E.*, A **26** 532], *Sesamia uniformis* Dudgn. and *Chilo suppressalis* (Wlk.) (*simplex* (Btlr.)). Adults were present in large numbers in sugar-cane and sorghum fields in Aligarh from May to November, but became less numerous from December to March, after which there was a slight increase. They were also observed resting and pairing on neighbouring wild grasses and bushes.

In rearing experiments, the adults were kept in glass troughs 4½ ins. cube, covered with muslin and containing pieces of sorghum stem as resting places and cotton-wool soaked in sugar as food. Squashed or soaked raisins were also accepted. For oviposition, a rectangular cavity was cut in a piece of fresh sorghum stem, a larva inserted into this, and a piece of rind tied over the opening so as to leave a slit down one side. This was placed in a test-tube containing wet sand, and a female parasite was introduced. The females did not oviposit until about 11 days after emergence in winter, when they paralysed the host through the slit and later laid a single egg on it. The parasitised host survived for only a short time, and if no other was available, other eggs were subsequently laid on it. The females deposited up to 32 eggs each, but the usual number was 22 or even fewer during

winter. Parasitised hosts were transferred to a trough of sand kept moist to prevent the sorghum from drying out, and heat was provided in winter. The total duration of development was 46–58 days in winter at temperatures ranging from 57 to 104°F., and 22–26 days during the pre-winter period at temperatures of 69–107°F. Observations on stored stems in godowns showed that development was delayed during winter, averaging 104 days between October and April. Parthenogenesis was common during winter, the progeny being all males. The average length of life of the males was 37 days; the females died immediately after oviposition. Precautions to be adopted so as to obtain the best results in rearing the parasite, and factors contributing to its effectiveness in the field are briefly discussed; the latter include a shorter life-cycle than those of its hosts and the absence of hyperparasites.

Day (M. F.), Irzykiewicz (H.) & McKinnon (A.). **Observations on the Feeding of the Virus Vector *Orosius argentatus* (Evans), and Comparisons with certain other Jassids.**—*Aust. J. sci. Res.* (B) **5** no. 1 pp. 128–142, 7 figs., 12 refs. Melbourne, 1952.

The feeding processes of several Jassids were studied at Canberra in connection with investigations on the transmission of plant viruses by *Orosius argentatus* (Evans). The species studied were *O. argentatus*, *Eurinoscopus punctatus* Evans, *Nesoclutha obscura* Evans, *Erythroneura ix* Myers, *Limotettix* sp. and *Euscelis* sp., and each produced characteristic stylet sheaths when allowed to feed on petioles of *Malva parviflora*. All species fed to varying degrees in both the parenchyma and the vascular bundles; they exhibited widely differing degrees of preference for the phloem, and a comparison of the feeding tracks of *Orosius* in *Malva*, beet leaves and petioles, and the petioles of *Datura stramonium* and of those of *Eurinoscopus* in *Malva* and lucerne stems showed that the frequency with which the phloem was reached varied with the food-plant. The feeding tracks of nymphs of *Orosius* in *Datura* resembled those of the adults, but were slightly shorter.

It appears that some Jassids can distinguish the tissues on which they feed, since the feeding tracks of *Orosius* were often larger when terminating in the phloem than in the xylem, *Limotettix* fed more frequently on phloem than on other tissues, feeding tracks more often curved towards than away from the phloem, and most examples of *Limotettix*, *Orosius* and *Euscelis* fed on the veins on the lower surface of the leaf. It has been suggested that *Circulifer tenellus* (Baker) locates the phloem in beet by means of a pH gradient [*R.A.E.*, A **25** 288], but attempts to demonstrate the occurrence of such gradients in the petioles of beet, pumpkin, tomato and tobacco were either unsuccessful or gave inconsistent results. Furthermore, the distribution of feeding tracks of *Orosius* in the petioles of two beet plants differing in the pH of their tissues was similar, feeding tracks ended in phloem tissue no more frequently in young pumpkin leaves, in which the vascular bundles are alkaline, than in beet, and most of the tracks in *Malva* were straight and did not suggest a response to a gradient.

It appeared from the results that *Erythroneura* and *Nesoclutha* feed primarily on the parenchyma and would therefore not be effective vectors of phloem-restricted viruses, that *Orosius*, *Eurinoscopus* and *Euscelis* feed on whatever tissues they reach in preliminary probings, the phloem being reached in 30–50 per cent. of cases, and feed longer on phloem than on parenchyma, and that *Limotettix* reaches the phloem on a significantly greater number of occasions than would be expected by chance but, unlike *Orosius*, probes several times before feeding and generally leaves feeding tracks only when it reaches the phloem; it is therefore suggested that the tissue reached by all these Jassids depends solely on chance. On the basis

of ability to reach the phloem and to feed without damaging the tissues, the order of decreasing effectiveness as virus vectors would be *Limotettix*, *Orosius*, *Euscelis* and *Eurinoscopus*. It is pointed out that the amount of injury to the tissues appears to increase with the size of the Jassid, and that most Jassid vectors of viruses are small.

WATERHOUSE (D. F.). **Studies on the Digestion of Wool by Insects. IV. Absorption and Elimination of Metals by Lepidopterous Larvae, with special Reference to the Clothes Moth,** *Tineola bisselliella* **(Humm.).**—*Aust. J. sci. Res.* (B) **5** no. 1 pp. 143–168, 2 pls., 8 figs., 32 refs. Melbourne, 1952. **V. The Goblet Cells in the Midgut of Larvae of the Clothes Moth** (*Tineola bisselliella* **(Humm.)) and other Lepidoptera.**—*T.c.* pp. 169–177, 3 pls., 1 fig., 12 refs. **VI. The pH and Oxidation-reduction Potential of the alimentary Canal of the Clothes Moth Larva** (*Tineola bisselliella* **(Humm.)).**—*T.c.* pp. 178–188, 1 fig., 22 refs. **VII. Some Features of Digestion in three Species of Dermestid Larvae and a Comparison with** *Tineola* **Larvae.**—*T.c.* no. 4 pp. 444–459, 1 pl., 1 fig., 39 refs.

The first of these four parts of a series [*cf. R.A.E.*, A **41** 23] contains a detailed account of experiments on the fate of 30 metallic and five non-metallic elements incorporated in woollen fabric or a yeast-casein medium when ingested by larvae of *Tineola bisselliella* (Humm.). The work was carried out because it had been expected that reduced wool in which the cross-linkages were reconstructed by treatment with toxic metal salts instead of alkylene dihalides [*cf.* **39** 5] would be either indigestible or, if digestible, highly toxic to the larvae owing to the rupture of the metal-sulphur linkages, but preliminary experiments with reduced wool treated with a mercury salt showed that the larvae suffered no harmful effects, though blackening of the faeces and the wool fibres in the mid-gut indicated that mercury had been liberated. The following is largely the author's summary of the results. It was found that 19 elements that form insoluble sulphides produced characteristically coloured sulphides in the food undergoing digestion in the mid-gut as a result of the reduction by the alkaline, highly reducing, mid-gut secretions of the disulphide bonds of the cystine present in the wool to form sulphydryl groups. When metal was present in the diet, less cystine was excreted than usual. Other sulphur-containing compounds, such as methionine and glutathione, also permitted the formation of sulphides. Much of the sulphide formed passed out of the body, but a certain amount formed highly dispersed colloidal solutions with the amino acids or polypeptides liberated by digestion of the food or present in the digestive secretions. These colloidal sulphides were taken up by the epithelium of the mid-gut, and sulphide granules, accumulated in the goblet cells of the anterior and posterior regions and, in the case of some metals, the middle region of the mid-gut, and were eliminated during moulting, when the epithelium was cast off. The goblet cells of several other Lepidopterous larvae accumulated some metals, but not as sulphides. Elements incapable of forming insoluble sulphides did not form coloured compounds in the goblet cells. However, the alkaline earths were deposited as granules, mainly as phosphates and principally in the columnar cells of the anterior and posterior mid-gut. It is probable that small quantities of absorbed fluoride were deposited with calcium in these granules.

In the second part, the goblet cells of *T. bisselliella* are described in detail and compared with those of other Lepidopterous larvae. The third contains an account of comparative studies on the pH concentration and oxidation-reduction potential of the contents of the alimentary canal of larvae of

T. bisselliella and of the goblet cells of the anterior and posterior mid-gut, which indicate that these cells are more likely to be concerned with storage and excretion than with the production and accumulation of digestive secretions.

The fourth paper contains an account of experiments on the digestion of wool by Dermestid larvae, carried out mostly with *Anthrenocerus australis* (Hope), *Anthrenus verbasci* (L.) and *Attagenus piceus* (Ol.), all of which were shown to be capable of digesting wool. The following is based on the author's summary. The mid-gut of these species is not differentiated into zones, and the epithelium consists of columnar cells with small groups of regenerative cells. A peritrophic membrane is present. There are virtually no tracheae in the mid-guts of *Anthrenocerus* and *Anthrenus*, and the tracheation in that of *Attagenus* is comparable with that of *T. bisselliella* [*cf.* **41** 24]. The reduction-oxidation potential is of the same order as that of *T. bisselliella*, but the pH is lower. These conditions permit the reduction of the disulphide bonds of wool keratin and attack by proteolytic enzymes, but most of the cysteine thus produced passes out of the body without further reduction. Dermestid larvae differed from larvae of *T. bisselliella* in producing metal sulphides only under exceptional circumstances, and the faeces produced following the ingestion of metal salts were usually of the normal colour. In tests with silk, larvae of *Anthrenocerus* were unable to digest the water-soluble fraction, comprising fibroin and sericin C, that forms the bulk of the raw fibre, and the available evidence indicates that this is also true of *T. bisselliella*.

MYERS (K.). **Oviposition and Mating Behaviour of the Queensland Fruit-fly (*Dacus* (*Strumeta*) *tryoni* (Frogg.)) and the Solanum Fruit-fly (*Dacus* (*Strumeta*) *cacuminatus* (Hering)).**—*Aust. J. sci. Res.* (B) **5** no. 2 pp. 264–281, 4 graphs, 27 refs. Melbourne, 1952.

Allman's method of breeding *Dacus tryoni* (Frogg.) in the laboratory in Australia [*R.A.E.*, A **27** 345] proved unsuccessful in repeated experiments, and a fresh method was devised. The flies were kept in cages of flint glass, 8 × 3 × 12 ins. in size, with a sleeve of fine muslin replacing the glass at one end and a strip of dark paper glued to the ceiling to provide a dark resting place, in a room with a large south window covered with celluloid, in which a temperature of 22–24·5°C. [71·6–76·1°F.] and a relative humidity of 62–68 per cent. were maintained during the cooler months of the year. Six pairs of flies were used per cage, and a mixture of 60 ml. papaya paste, 10 ml. banana paste, 6 ml. peeled orange and 1 ml. honey was provided as food; water was supplied in small jars plugged with cotton-wool, and the plugs were changed and the cages washed at frequent intervals. Five cages were set round a clear 150-watt lamp at a distance of 12 ins. from it and were illuminated by it for 7½ hours daily, a period of dusk before dark being ensured. A pricked apple was provided for oviposition [*cf. loc. cit.*] and renewed twice a week, but, because the eggs and young larvae were not easily visible, counts were not made until the larvae had reached an advanced stage of development. When further adults were required, infested apples were placed on sand in pupation cages of mesh fine enough to exclude *Drosophila* and the puparia subsequently sieved or washed from the sand and placed in small emergence tubes, where they were again covered with sand. Under these conditions, eggs (squeezed from tomato) hatched in about 43 hours, most larvae pupated about 13 days after the eggs had been laid, and most adults emerged after a pupal period of 13 days. The pre-oviposition period lasted 14–21 days.

The numbers of larvae produced each week showed considerable variation,

much of which is probably inherent in the species. In comparative tests, the numbers were more than doubled when daylight was supplemented by artificial light, and no larvae resulted when the flies were kept in darkness. A dusk period prior to dark was found necessary to induce pairing, the manner of which is described, but simulated dusk was ineffective if it began more than 70 minutes before sunset. Mating activity ceased when the electric lamp was switched on or the room was darkened and was renewed when dusk conditions were restored. Male mating activity was more intense after strong than after low light intensities during the day.

The method of rearing also proved suitable for the solanum fruit-fly, *D. cacuminatus* (Hering),* when ripening tomatos were substituted as the host fruits. Mating behaviour was similar to that of *D. tryoni*. These two species are sympatric and did not interbreed in the laboratory; the barriers to crossing are discussed.

STUBBS (L. L.). **Further Host Range and Transmission Studies with a Virus Disease of Carrot endemic in Australia.**—*Aust. J. sci. Res.* (B) **5** no. 4 pp. 399–408, 3 pls., 5 refs. Melbourne, 1952.

An account is given of further studies on the host range of a virus disease of carrots in Victoria [*R.A.E.*, A **37** 275], undertaken in an attempt to establish the identity of the virus, which had hitherto been transmitted only to umbelliferous plants. In tests, it was transmitted by *Cavariella aegopodii* (Scop.) to *Datura stramonium*, *Capsicum annuum*, *Nemesia*, tobacco and petunia, provided that groups of 10–20 vigorous Aphids bred on recently infected carrot and starved for 24 hours, preferably at 50–55° F., prior to use were placed on each test plant and that the feeding cages were only large enough just to enclose the test plant. Small vigorous plants were easier to infect and developed more severe symptoms than larger plants. The Aphid was unable to recover the virus from these plants, which were extremely unpalatable if not toxic to it, or to transmit it from carrot to tomato, spinach, sugar-beet, *Nicotiana glutinosa*, *N. sylvestris*, *Lupinus angustifolius*, vetch (*Vicia sativa*) or *Calendula officinalis*. The virus was transmitted to tobacco, but not carrot, by sap inoculation from infected petunia. Heteroplastic grafts between infected petunia and healthy carrot resulted in two infections in the latter species, although graft unions were not recorded. Symptoms on all hosts except *D. stramonium* were masked by rising temperatures and intensified by low temperatures. Petunia, tobacco and *D. stramonium* are regarded as good differential hosts. It is concluded that the virus is distinct from any previously described, and the name "carrot motley dwarf" is therefore proposed for the disease caused by it.

MAY (A. W. S.). **Potato Tuber Moth** (*Gnorimoschema operculella* (**Zell.**)) **Investigations in southern Queensland.**—*Qd J. agric. Sci.* **9** no. 2 pp. 142–168, 4 figs., 18 refs. Brisbane, 1952; also as *Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 61, 27 pp., 4 figs., 18 refs. Brisbane [1953].

Measures for the protection of spring-planted potatoes from infestation by *Gnorimoschema operculella* (Zell.) were investigated in southern Queensland, where the plants are liable to attack almost throughout the growing period.

* *Dacus cacuminatus* (Hering, 1941) (= *solani* (Perkins & May, 1949)) is the fly for which the name *solani* was cited in a varietal sense in the earlier Australian literature [*cf. R.A.E.*, A **10** 416; **12** 235; **14** 367]; it was subsequently misidentified as *D. dorsalis* Hend. [**15** 317; **20** 156; **25** 164, 378; **28** 291; **30** 498], which is not known to occur in Australia.—*Ed.*

In comparative tests in 1948, DDT was applied as a 0·1 per cent. spray or a 2 per cent. dust at rates in general approximating to 1 lb. DDT per acre per application in schedules comprising two applications separated by an interval of ten days (of which the first was made when moth activity was first noted), a single application three weeks before harvest, or all three applications. In 1949, when abnormal rainfall interfered with treatment, and again in 1950, the value of the dust and spray was compared with that of earthing up the plants soon after flowering with or without a repetition of this three weeks later. The results are given in detail and discussed.

The spray proved more effective than the dust in causing rapid reductions in adult populations and in destroying the larvae in their mines, and in 1950 also was greatly superior in preventing larval infestation of the foliage. Sprayed plants produced significantly fewer infested tubers than dusted or control plants, between which there was little difference. Furthermore, the dust was almost twice as costly as the spray. The weight of foliage from sprayed plots was significantly greater than that from the controls, and though this was largely due to the reduction of *G. operculella*, the spray also controlled *Austroasca viridigrisea* (Paoli), *A. alfalfae* (Evans), *Orosius argentatus* (Evans), *Macrosiphum solanifolii* (Ashm.) (*gei*, auct.) and *Epilachna vigintioctopunctata* (F.). As a result of freedom from attack, the number and weight of tubers produced per sampling unit were increased by up to 17 and 43 per cent., respectively. The effect of earthing up varied with potato variety, owing to differences in length of stolon. When carried out late in the season, it caused a significant reduction in tuber infestation and was especially beneficial where harvesting was delayed, but resulted in reduced yields when carried out within ten weeks of planting. Since neither spraying with DDT nor earthing up gives complete protection, a schedule comprising two or, if necessary, three sprays of 0·1 per cent. DDT at 1 lb. DDT per acre made at fortnightly intervals beginning when moth activity becomes apparent, combined with earthing up not earlier than 12–14 weeks after planting, is recommended. In observation plots in which this treatment was followed in 1951, the foliage developed normally and less than 5 per cent. of the tubers were infested, whereas crops inadequately sprayed with DDT were severely attacked.

JENKINS (C. F. H.). **Fuller's Rose Weevil** (*Pantomorus godmani* **Crotch**). —*J. Dep. Agric. W. Aust.* (3) **1** no. 6 pp. 813–817, 3 figs., 3 refs. Perth, W.A., 1952.

Pantomorus godmani (Crotch) was observed in Western Australia for the first time in 1948, and was at the time of writing known to occur only in two districts, where it was injurious chiefly to *Citrus*. In view of the potential importance of the weevil, information is given on its bionomics and control, based mainly on experience in New South Wales [*cf. R.A.E.*, A **36** 344], together with a description of the adult. A dust of 10 per cent. BHC applied to the ground round the trees proved effective in preventing the adults from ascending them.

DALE (W. T.). **The Transmission of Plant Viruses by biting Insects, with particular Reference to Cowpea Mosaic.**—*Ann. appl. Biol.* **40** no. 2 pp. 384–392, 20 refs. London, 1953.

The author reviews the literature on the transmission of plant viruses by chewing insects and gives an account of work in Trinidad on the transmission of cowpea mosaic by adults of the Galerucid, *Andrector* (*Cerotoma*) *ruficornis*

(Ol.) [*cf. R.A.E.*, A **38** 149]. The following is taken from his summary of the results. Ability to infect decreased with increasing time after ceasing to feed on infected plants, but vectors remained infective for 14 days (much longer than the longevity *in vitro* of the virus at glasshouse shade temperatures of 23–31°C. [73·4–87·8°F.]); the beetles transmitted more consistently after longer feeding on infected plants, though feeds of under 5 minutes made them efficient vectors; the proportion of plants infected increased with the amount of feeding damage on them; starving the vectors before feeding on infected plants increased voracity but had no effect on their ability to transmit; beetles became infective immediately after feeding on infected plants. Cowpeas were infected by inoculation with macerated infective vectors or with juice regurgitated by vectors. There is no evidence that Aphids or other sucking insects can transmit the virus [*cf.* **38** 150]. It seems similar to squash mosaic [*cf.* **29** 500, 501] and turnip yellow mosaic [*cf.* **40** 141], for vectors of all three viruses probably transmit by regurgitating infective juice during feeding [*cf.* **40** 142].

Hamlyn (B. M. G.). **Quantitative Studies on the Transmission of Cabbage Black Ring Spot Virus by** *Myzus persicae* **(Sulz.).**—*Ann. appl. Biol.* **40** no. 2 pp. 393–402, 15 refs. London, 1953.

The following is substantially the author's summary of this account of experiments on the transmission by *Myzus persicae* (Sulz.) of a virus found in swede plants at Rothamsted and thought to be related to cabbage black ring spot virus. Factors affecting the transmission of the virus by *M. persicae* were studied quantitatively by counting the local lesions produced when infective Aphids fed on tobacco leaves. Aphids prevented from feeding for 15 minutes or more before feeding for a few minutes on an infected plant caused more infections than unstarved Aphids. Starved Aphids acquired virus from infected plants in feeding times as short as ten seconds, and infected healthy plants in test-feeding times of five seconds. Increasing test-feeding times to 30 minutes increased the numbers of infections. Increasing infection-feeding times from ten seconds to five minutes had little effect, but increasing to more than five minutes greatly reduced the number of transmissions. This reduction was partly offset if the Aphids were prevented from feeding continuously while on the infected plants. With undisturbed infection-feeding periods of 15 minutes or longer, previously starved Aphids caused no more infections than unstarved ones. Infective Aphids lost their ability to produce lesions more rapidly when feeding than when fasting. Winged and wingless Aphids were equally efficient vectors.

David (W. A. L.) & Gardiner (B. O. C.). **The systemic insecticidal Action of Sodium Fluoroacetate and of three Phosphorus Compounds on the Eggs and Larvae of** *Pieris brassicae* **L.**—*Ann. appl. Biol.* **40** no. 2 pp. 403–417, 1 fig., 9 refs. London, 1953.

The following is largely the authors' summary. Schradan, paraoxon, bis-(dimethylamino) fluorophosphine oxide and sodium fluoroacetate (the last two being referred to as the oxide and acetate, respectively), all of which have previously been shown to possess systemic insecticidal activity against Aphids [*R.A.E.*, A **39** 199], were tested against eggs and larvae of *Pieris brassicae* (L.) on cabbage or brussels sprouts in the greenhouse. Schradan proved to have very little toxic action on eggs or larvae, but the other three compounds showed both contact toxicity in dips and systemic action

when taken up by the roots from solution and from soil. The acetate, and more especially paraoxon, also showed systemic action after application to the leaves. In all cases, the order of decreasing toxicity was paraoxon, acetate, oxide, schradan. Paraoxon was the only compound that was outstanding when absorbed from the soil, it proved more toxic to the third-instar larvae than to Aphids, and though it did not prevent the eggs from developing, it killed the larvae in the act of hatching. Unless it is considered too poisonous, paraoxon is worthy of consideration for use against *Pieris*.

Maqsud Nasir (M.). **Stability of Contact Insecticides. IV. Relationship between the ultra-violet Absorption Spectrum and the Photolysis of DDT and the Pyrethrins.**—*J. Sci. Fd Agric.* **4** no. 8 pp. 374–378, 2 graphs., 18 refs. London, 1953.

This fourth part of a series [*cf. R.A.E.*, A **41** 348, etc.] contains the results of experiments in which the photolytic action on DDT and the pyrethrins of ultra-violet light of narrow wavebands between 4,000 and 1,800 Å was investigated by introducing into the optical system cells containing liquids that cut off different fractions of the ultra-violet. Filter papers impregnated with insecticide were irradiated for 20 minutes and then compared with unirradiated ones by bioassay [*cf. loc. cit.*] to determine the fraction of insecticide rendered inactive. As the different filters used transmitted different amounts of light, which was in any case not emitted in uniform intensity over the whole range, the transmitted intensities were measured in separate experiments and the percentages of insecticide decomposed adjusted accordingly. To estimate the decomposition associated with any particular waveband, the difference was taken between the fraction decomposed when the filter transmitted this and light of greater wavelength and that decomposed when a filter was used that just excluded it.

Comparison of graphs showing the degree of decomposition of DDT by light of different wavelengths and the ultra-violet absorption spectrum of DDT indicated that the decomposition of DDT varies with the amount of light absorbed, which is greatest at wavelengths of 2,200–2,400 Å. Some absorption occurs with light of up to 2,800 Å, and decomposition of DDT was observed at all wavelengths up to 2,850 Å. As ferric ions, which have been shown to catalyse the decomposition of DDT by alkali, may occur on naturally irradiated substrates for DDT formulations, insecticidal films were prepared on filter papers that had been moistened with ferric-chloride solution and dried. When these were irradiated and compared with similar unirradiated films and irradiated films prepared without the chloride, it was observed that 33 per cent. of the DDT deposit that would have undergone photolysis was protected by the latter. The dried deposit of ferric chloride was partly hydrolysed to the hydroxide. The extent to which reflection and absorption determine the protective action is not known.

Comparison of graphs showing the decomposition of pyrethrins and their ultra-violet absorption spectrum showed that decomposition was most severe at about 2,200–2,400 Å, where the light is strongly absorbed, but that there was considerable decomposition even at wavelengths where it is not, throughout the range from 2,400 Å to the visible region, probably as a result of light-catalysed oxidation rather than of direct photolysis.

The results of the investigations showed that the rapid photolysis of DDT and pyrethrum films is associated with a waveband of 2,200–2,400 Å, and the rapid breakdown of pyrethrum films and the reported decomposition of DDT films in direct sunlight suggested that the latter included the critical waveband, instead of terminating abruptly at about 2,900 Å, as considered by some. This was supported by the results of further tests.

Brown (W. B.) & Heuser (S. G.). **Behaviour of Fumigants during Vacuum Fumigation. II. Penetration of Methyl Bromide into bagged Wheatfeed, and related Diffusion Experiments.**—*J. Sci. Fd Agric.* **4** no. 8 pp. 378–386, 10 graphs, 3 refs. London, 1953.

An account is given of further investigations of the effect on the penetration of a fumigant applied by the sustained-vacuum method when atmospheric pressure is restored some time before the end of the exposure period [*cf. R.A.E.*, A **41** 350]. When single 112-lb. bags of wheatfeed with a moisture content of 11 per cent. were fumigated at 15°C. [59°F.] with methyl bromide at nominal concentrations of 40–48 mg. per litre, treatment at atmospheric pressure resulted in a penetration factor [*cf. loc. cit.*] at the centre of the bag of only 18 after four hours. Vacuum fumigation with simultaneous admission of air and fumigant caused no greater penetration, and no initial peak concentration at the centre, as previously observed with dates [*cf. loc. cit.*], owing to the rapid sorption of methyl bromide by the outer layer of the finely divided wheatfeed. Vacuum treatment with release of vacuum after 3 hours 10 minutes resulted in very good penetration throughout the bag within one hour, with a characteristic peak concentration (though smaller and less lasting than in dates) after the restoration of atmospheric pressure, and a penetration factor of 79 at the centre after four hours, as compared with an estimated factor of 70 for treatment at reduced pressure throughout the period.

Similar experiments with a nominal concentration of 95 mg. per litre gave correspondingly higher concentration-time products but almost the same penetration factors; the restoration of atmospheric pressure after 3 hours 15 minutes again resulted in a useful increase in the penetration factor at the centre over that obtained by the sustained-vacuum method.

When vacuum fumigation was carried out with a nominal concentration of 70–80 mg. per litre, restoring atmospheric pressure after one hour, 2 hours 10 minutes and three hours resulted in similar increases in concentration at the centre of the bag and penetration factors of 94, 90 and 74, respectively, at the end of four hours. Restoring atmospheric pressure immediately after the introduction of the fumigant and before it had penetrated into the bag adequately resulted in no sudden increase in concentration at the centre, evidently owing to sorption in the outer layers. The gas taken up by these quickly approached equilibrium with that in the free space, after which sorption caused little hindrance to diffusion through them. This more rapid diffusion through the outer layers allowed the concentration at the centre to rise more rapidly than in treatment entirely at atmospheric pressure; similar results were not obtained with simultaneous admission of air and fumigant. The penetration factor at the centre was only 51 after four hours in this test.

The influence of the sorption of the fumigant by the commodity on the relation between the total pressure of fumigant and air and the rate of diffusion of the fumigant was investigated at 15°C. by measuring the diffusion of methyl bromide, carbon dioxide, which shows negligible sorption by wheatfeed, and hydrogen cyanide, which is sorbed to a greater extent than methyl bromide, along a horizontal column of wheatfeed at atmospheric and reduced pressures (76 and 7 cm.). Samples taken 2, 10 and 18 inches from the end exposed to the fumigant showed that the three gases differed widely in rate of penetration, carbon dioxide penetrating most rapidly and HCN least; HCN failed to reach the 10-inch point at atmospheric pressure or the 18-inch point at reduced pressure in four hours. The times required for the concentration to reach 20 per cent. of that in the free space to which the surface of the wheatfeed was exposed were 260 and 33 minutes at atmospheric and reduced pressures for methyl bromide at a distance of

ten inches, 118 and 12 minutes for carbon dioxide at 18 inches, and 106 and 12 minutes for HCN at two inches, the ratios of the times taken by each gas at the two pressures (8 : 1–10 : 1) differing little from the ratio of the pressures themselves. These results indicate that the effect of sorption on the rate of penetration of a gas into a bulk of material is not affected by the total pressure, that the rate of penetration is inversely proportional to total pressure, and that the lower the working pressure, the greater the rise in concentration within the package when atmospheric pressure is restored.

Razvyazkina (G. M.). **The Tobacco Thrips—the Vector of Tip Chlorosis of Makhorka.** [*In Russian.*]—*Zool. Zh.* **31** no. 1 pp. 44–46. Moscow, 1952. **The Importance of the Tobacco Thrips in the Development of Outbreaks of Tip Chlorosis of Makhorka.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **18** no. 6 pp. 27–31, 5 refs. Moscow, 1953.

It is stated in the first paper that tip chlorosis of makhorka [*Nicotiana rustica*] was first observed in the Province of Poltava (Ukraine) in 1944, since when it has become one of the principal diseases of that crop. It usually begins with discoloration along the veins of the topmost leaves or the appearance of a chlorotic pattern on them. The growth of affected plants is retarded, and though they flower and produce seeds, the leaves are small, wrinkled and brittle. Observations begun in 1947 showed that the incidence of the disease was greatest near weeds harbouring sucking insects and that it markedly decreased after dusting with DDT, which indicated transmission by insects. The only weed showing symptoms of the disease was *Sisymbrium* sp., and *Thrips tabaci* Lind. was very numerous on this.

In tests with potential vectors, batches of *T. tabaci*, *Myzus* (*Myzodes*) *persicae* (Sulz.), ten species of Jassids and two of Heteroptera were collected from makhorka and released separately in field cages containing healthy makhorka plants. All the plants on which *T. tabaci* was liberated subsequently developed the disease, the symptoms appearing after 14–20 days, and none of the others did so; infection in the controls, which were exposed to natural field infestation, reached 50·3 per cent. Similar results were obtained in a further test with *T. tabaci*, and it is concluded that this thrips is the vector.

In the second paper, the virus of tip chlorosis is stated to belong to the group of tomato spotted wilt, which is also transmitted by *T. tabaci*, and to be not seed-transmissible. The main reservoir of infection is *Sisymbrium*, and observations showed that makhorka became infected only after *T. tabaci* had begun migrating to it, the disease appearing at the edges of the fields near stands of weeds on which the overwintered thrips congregated. The latter emerged from the soil over a long period, so that even late sowings of makhorka became infested, but early ones suffered less from infection than might be expected, because of their more advanced state of development at the time of infestation. Early sowing is therefore recommended. Even one infective thrips was able to infect a plant, so that the size of the population per plant is of little significance. Field observations in 1951 and 1952 showed that the thrips appeared on makhorka in mid-May or the beginning of June and were present at the rate of 200–400 per leaf at the end of the summer; the percentage of infected plants increased during the season from 5–12 to 90–95 and that of infective thrips, which is the decisive factor, rose to 95–98.

Observations in an insectary in the summer of 1952 showed that the virus was transmitted by any of the feeding stages of *T. tabaci*, a feeding period

of five minutes on a healthy plant proving sufficient, but was acquired only by the nymphs, the minimum feeding period on the source of infection being 30 minutes. Unless the thrips acquire infection before they become adult, therefore, they remain non-infective. In tests in which nymphs were allowed to feed on a diseased plant for 24 hours and were then transferred daily to successive healthy ones, no plants before the third became infected, indicating that the incubation period in the thrips lasts at least three days. After acquiring the infection as nymphs, the thrips were able to transmit it for the rest of their life. When thrips bred on diseased makhorka were allowed to reproduce on cucumber, which is immune from the virus, and their progeny were transferred as nymphs to healthy makhorka, the latter did not contract the disease, showing that the virus is not transmitted through the eggs of the thrips to the subsequent generation.

Sȳsoev (A. T.). **The Possibility of combining biological and chemical Methods in the Control of Pests of agricultural Crops.** [*In Russian.*] —*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **18** no. 7 pp. 26–31. Moscow, 1953.

Experiments were carried out in the laboratory and field near Sochi, on the Black Sea coast of the Caucasus, in 1950–52 to study the possibility of using *Cryptolaemus montrouzieri* Muls. for the control of mealybugs on plants treated with chemicals against other pests. The general method adopted in the laboratory was to release larvae and adults of the Coccinellid on cucurbits infested by *Planococcus (Pseudococcus) citri* (Risso) 1–30 days after these had been treated with the test chemicals and estimate their survival 5–30 days later.

When the beetles were released in the laboratory on plants dusted with sulphur against mites, all the adults and most of the larvae died in 20 days when the releases took place up to 20 days after dusting and there was very little feeding on the mealybug. The Coccinellid should therefore not be released in greenhouses until the plants have been freed from sulphur dusts by thorough washing with water. In the open, *Cryptolaemus* became established and reproduced on lemon trees infested by *Pseudococcus maritimus* (Ehrh.) when placed on them 30 days after they had been dusted with sulphur, and the mealybugs were soon destroyed. They abandoned the trees, however, when placed on them 15 days after dusting. They also became established on grape vines infested by *Planococcus citri* and dusted one month previously, destroying all the mealybugs in about six weeks.

Sprays of lime-sulphur (0·5°Bé) applied 24 hours previously had no appreciable effect on the beetles in the laboratory or field, mortality only slightly exceeding that in the controls and the appearance of larvae being retarded by only about ten days. Spraying with lime-sulphur is thus much safer than dusting with sulphur and should be substituted for it in indoor applications. In practice, a period of 30–45 days is necessary for *Cryptolaemus* released at the rate of 25 adults per *Citrus* tree or three per fully grown vine to clear them of mealybugs, and dusting with sulphur or spraying with lime-sulphur should not be carried out during this time. *Cryptolaemus* is best liberated on *Citrus* against *Pseudococcus gahani* Green and *P. maritimus* at the end of May or the beginning of June, when the first generation of the year is present and mite control is not yet necessary. The predator will destroy all the mealybugs by July, and the trees can then be treated against the mites. If *Cryptolaemus* is to be released at the end of July against mealybugs of the second generation, lime-sulphur should be

applied against the mites in early July and again in September. Vines on which *Cryptolaemus* is to be released should be dusted with sulphur against mites before mid-June and again, if necessary, at the end of August.

Spraying with 1 per cent. bordeaux mixture had little effect on *Cryptolaemus* released in the laboratory 24 hours after treatment, and none in the field when applied in mid-August to trees on which the Coccinellid had already been liberated. Similar results were obtained with sprays of 4 lb. anabasine sulphate and 8 lb. soap per 100 gals. and a 2 per cent. oil emulsion prepared with hydrated copper sulphate, and fumigating with hydrogen cyanide released from sodium cyanide used at 3 oz. per 200 cu. ft. had no effect on beetles released on the following day. As a precaution in greenhouses, however, *Cryptolaemus* should not be released on fumigated plants until all traces of the gas have been removed by thoroughly washing the plants and the buildings and ventilating for 5–6 hours.

DDT, BHC and parathion were tested in the laboratory only. Dusts of DDT and BHC killed all the adults and larvae released on the treated plants for up to 30 days after treatment, and BHC had a repellent effect for at least two months. The latter was also toxic to *Planococcus citri*, especially the first- and second-stage nymphs. Parathion is also toxic to *P. citri*, but the spray used lost its effectiveness in about a fortnight and the beetle was released without loss 20 days after treatment.

Paĭkin (D. M.) & Mende (P. F.). **An Experiment in chemical Control of the Noxious Little Tortoise.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **18** no. 8 pp. 18–20. Moscow, 1953.

An account is given of experiments in the Soviet Union in 1949–52 on the use of dusts and sprays against the hibernating adults of *Eurygaster integriceps* Put. in forest litter. The insecticides tested included DDT, BHC, parathion and a number of materials of unspecified composition, but the best results were given by methane sulphonyl fluoride [*cf. R.A.E.*, A **40** 325] in green oil [*cf.* **41** 295]. This gave 66·7 per cent. mortality when applied in autumn at temperatures of 6°C. [42·8°F.] or −3°C. [26·6°F.] at the rate of 4·5 lb. of the fluoride in 45 gals. oil per acre, the litter being loosened at the same time, and 87·6 per cent. at twice the rate.

Ushatinskaya (R. S.) & Makhotin (A. A.). **The Action of Mineral-oil Emulsions of DDT on the Adults of the new Generation of the Noxious Little Tortoise.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **81** no. 5 pp. 969–972, 9 refs. Moscow, 1951.

Investigations in the Soviet Union have shown that DDT dusts are effective against nymphs of *Eurygaster integriceps* Put. in the first three or four instars and the overwintered adults, but are of little value against fifth-instar nymphs or young adults [*cf. R.A.E.*, A **42** 70, etc.]. This was believed to be due to the development of a wax layer in the epicuticle, which hindered the penetration of the chemical, but which apparently disappeared during hibernation, and some support for this view was provided by the finding that DDT in kerosene is toxic to the apparently resistant adults [*cf. loc. cit.*]. The effect of emulsified solutions of DDT in mineral oil was therefore investigated in 1951. Three emulsion concentrates were used, the first containing 20 per cent. DDT, 40 per cent. spindle oil, 6 per cent. sulphite lye and 34 per cent. water, the second containing 20 per cent. DDT, 30 per cent. spindle oil, 5 per cent. sulphite lye, 10 per cent.

chlorobenzene (as an intermediate solvent) and 35 per cent. water, and the third containing 20 per cent. DDT, 35 per cent. diesel oil, 5 per cent. sulphite lye and 35 per cent. water.

Sprays of 1, 2 and 3 per cent. of these concentrates were applied in the laboratory to nymphs in the fourth and fifth instars and newly emerged adults, which were then transferred to jars containing damp soil and wheat ears and observed for mortality after five days. The results showed that mortality was complete or almost complete for the fourth-instar nymphs, somewhat lower for the fifth-instar nymphs, though the third concentrate at 3 per cent. killed all of them, and considerably lower for the adults, the highest kill being 87·5 per cent. for the second concentrate at 3 per cent. In field tests, fifth-instar nymphs, newly emerged adults and adults that were ready to migrate for aestivation [*cf.* **40** 309–310] were collected in a field of wheat, sprayed with 2 and 3 per cent. of the concentrates and released in cages on wheat sprayed with the same materials. It was found after five days that the third concentrate gave the best mortality of the nymphs and young adults (92–98 and 97·4–99·7 per cent., respectively), but none was very toxic to the older adults, the first concentrate at 3 per cent. giving the highest mortality (58·1 per cent.). A 50 per cent. emulsion concentrate of pyrophos [? tetraethyl pyrophosphate (*cf.* **41** 335)] was also tested in these experiments, at 0·1–0·3 per cent. in the laboratory and 0·1 and 0·2 per cent. in the field. It proved extremely effective, giving complete or almost complete kill in all cases.

The DDT concentrates were subsequently applied in sprays at 8·8 gals. per acre from an aeroplane against adults ready to migrate from wheat. Plots were caged immediately after treatment, and mortality was again estimated after five days. The third concentrate proved the most effective, giving 34 per cent. mortality at a rate equivalent to 9 lb. per acre, and the first the least so, giving 23·8 per cent. kill at the same rate.

It is concluded that diesel oil penetrates the epicuticle better than spindle oil, even with an intermediate solvent, and that spraying is best carried out before the adults reach the resistant stage. The cause of this resistance is unexplained, but it is apparently due to some physiological change [*cf.* **40** 95].

Riehl (L. A.), Gunther (F. A.) & Beier (R. L.). **Application of Precision Photoelectric Colorimeter to Determination of Oil Deposit on Laboratory-sprayed Grapefruit.**—*J. econ. Ent.* **46** no. 5 pp. 743–750, 2 graphs, 14 refs. Menasha, Wis., 1953.

In view of the variation that occurs in the quantity of oil deposited by sprays of equivalent oil content under both field and laboratory conditions, a method of using a precision photoelectric colorimeter to determine the amount of oil deposited by aqueous spray emulsions was developed in California, in order to study the efficiency of various petroleum-oil fractions against adults of *Aonidiella aurantii* (Mask.) and eggs of *Paratetranychus (Metatetranychus) citri* (McG.). Grapefruits were sprayed in the laboratory with emulsions of petroleum oils containing a predetermined proportion of a red oil-soluble dye, the dyed oil was stripped from the sprayed fruits immediately afterwards with a fine jet of dioxane, and the volume of fluid draining from the fruits determined. The concentration of dye in this was determined by means of the colorimeter and used to calculate the weight of oil that had been deposited on the fruits. Data to indicate the precision and sensitivity of the method are presented, and its limitations are discussed.

Terriere (L. C.) & Ingalsbe (D. W.). **Translocation and residual Action of Soil Insecticides.**—*J. econ. Ent.* **46** no. 5 pp. 751–753, 5 refs. Menasha, Wis., 1953.

Investigations were carried out in Oregon in 1949–52 to determine whether crops grown in soil treated with various insecticides retained any of the toxicants. Most of the insecticides were applied in the spring of 1949, and all were tilled into the soil, a sandy loam, to a depth of six inches at the rate of 10 lb. active ingredient per acre, and potato tubers grown in the soil and the soil itself were examined for insecticide residues in 1950 and 1951 by a bioassay method using mosquito larvae [*cf. R.A.E.*, A **39** 6] and the soil also by chemical methods. Residues of DDT, BHC, toxaphene, chlordane, aldrin and dieldrin were found to persist in the soil for at least three years, although toxaphene and BHC appeared to lose much of their toxicity during that period, whereas EPN [ethyl p-nitrophenyl thionobenzenephosphonate] and parathion completely disappeared in less than three years. BHC, chlordane and dieldrin were present in the tubers after three years, and aldrin and EPN after two, though all residues were insignificant. Heptachlor was applied to the soil in the spring of 1951, and was found in the soil and in potatoes grown in it the same year. Limited tests afforded no evidence that chlordane, toxaphene and aldrin were translocated in carrots, dieldrin in string beans, aldrin in squash and aldrin and dieldrin in tomato.

It was confirmed that the benzene extracts from the potato tubers contained a natural toxicant that interfered with bioassay [*cf. loc. cit.*]; it was removed by pretreatment of the extract with 0·2 per cent. sodium hydroxide. The mosquito larvae used were *Aëdes vexans* (Mg.) and *A. sticticus* (Mg.) in 1950 and *Culex pipiens fatigans* Wied. (*C. quinquefasciatus*, auct.) in 1951. *Aëdes* larvae are the more sensitive to insecticides but difficult to rear in the laboratory; those of *Culex* are easily reared and tolerate a high proportion of decaying matter in the rearing medium.

Gambrell (F. L.). **Control of the European Chafer, *Amphimallon majalis* Raz., in Turf.**—*J. econ. Ent.* **46** no. 5 pp. 761–765, 8 refs. Menasha, Wis., 1953.

Amphimallon majalis (Razoum.), which is injurious to turf, had spread over an area of 500 sq. miles in New York State by 1952 [*cf. R.A.E.*, A **35** 250] and was observed in Connecticut in 1951. Field observations in New York in 1951–52 indicated that development proceeds more rapidly in mown than in long grass and during extended hot periods than in cool, wet weather. Experiments on control [*cf.* **40** 241; **41** 274] were carried out in 1944–52, and the following is based on the author's summary of the results.

DDT, applied at the rate of 25 lb. per acre or more to the soil to a depth of three inches, protected the turf from damage by the larvae. The degree of control obtained varied somewhat in different tests and from season to season in a given experiment, and it is considered that soil temperature, moisture content, ground cover and soil type all affect the depth at which feeding occurs and consequently control. Data from one test in 1951 are cited to show that at depths of 0–3 ins., the concentration of DDT was adequate to control larvae in the first instar but too low to kill older larvae. Lindane [almost pure γ BHC] used at 5–10 lb. per acre was as effective in 1952 as in 1951, but at 2·5 lb. it was somewhat less effective in 1952 than in 1951, when it proved fairly satisfactory. Chlordane, aldrin, dieldrin and heptachlor in the same test showed good control of larvae

of the second generation after treatment. All the chlorinated hydrocarbons tested proved quite toxic to larvae in all three instars; DDT must be used at 2–10 times the concentration of chlordane, lindane, dieldrin or heptachlor, but has the value of long persistence in the soil.

Howe (W. L.) & Campbell (W. V.). **Control of the Green June Beetle as a Pest of Ladino Clover.**—*J. econ. Ent.* **46** no. 5 pp. 766–771, 3 refs. Menasha, Wis., 1953.

The following is largely based on the authors' summary. Ladino clover [*Trifolium repens latum*] grown in pastures in the Tidewater area of south-eastern Virginia is seriously injured by larvae of *Cotinis nitida* (L.), which feed on decaying matter and burrow in the upper three inches of soil in the second and third instars, completely uprooting the stolons and seriously injuring the primary tap roots. Losses are particularly severe during dry, hot periods, when maximum root efficiency is needed, and pastures 2–3 years old on the lighter soils seem to attract the largest populations.

In experiments on control in 1951–52, insecticides of the persistent type were applied to the soil surface before the eggs hatched, usually during late June or early July, to prevent soil disturbance and plant injury, and these and parathion against larvae in the second and third instars during late August and September, when 90–95 per cent. of the eggs had hatched, to prevent further damage to clover that had already been injured. In both large and small plots, aldrin, dieldrin and heptachlor at 2 lb. per acre, γ BHC as lindane at 0·67 lb. and toxaphene at 20 lb. per acre were very effective against the first-instar larvae when applied just before hatching, but ineffective when applied later against the older larvae. Dusts, sprays and mixtures of insecticide with fertiliser or granular carriers were all satisfactory when effective insecticides were used. Granular carriers were especially suitable for broadcast distribution with ordinary fertiliser spreaders and were also applied by power dusters with some success. DDT, which persists for a relatively long time in the soil, was promising at 7·5 lb. per acre in preliminary tests and may fit into a long-range control programme.

Parathion at 0·5–1 lb. per acre controlled the second- and third-instar larvae in the later applications and was very effective, easy to apply by fertiliser spreader and less hazardous to the operators than dusts or sprays when impregnated on 30–60 mesh ground tobacco stems at a concentration of 0·75 per cent. When night temperatures fell below 55°F., the decreased surface activity of the larvae reduced its effectiveness. In a comparative test, methyl-parathion proved much less toxic.

Floyd (E. H.) & Smith (C. E.). **Pyrethrum and Lindane in the Protection of Corn and rough Rice from Stored Grain Insects.**—*J. econ. Ent.* **46** no. 5 pp. 771–774. Menasha, Wis., 1953.

Investigations were carried out in Louisiana in 1951–52 on the effectiveness of various proprietary preparations containing pyrethrins and piperonyl butoxide (PB) and also of γ BHC as technical lindane in protecting stored maize from *Sitotroga cerealella* (Ol.) and *Calandra (Sitophilus) oryzae* (L.) and unhusked rice from *S. cerealella* and *Rhizopertha dominica* (F.). The pyrethrum products were applied as fine mist sprays or as dusts sprinkled by hand, and lindane on impregnated crushed maize cobs (5 per cent. lindane) scattered among the ears or grain. Examinations were made 7, 10 and 11 months after treatment. Pyrenone Grain Protectant (a dust containing 0·05 per cent. pyrethrins and 0·8 per cent. PB) was used in all

tests of the pyrethrum products, and applications of any of them theoretically affording the equivalent of 0·032 oz. PB and 0·002 oz. pyrethrins per cwt. are referred to as the standard dose.

The maize was newly harvested, and 5 per cent. of the kernels were already damaged by stored-grain insects. In a test with the pyrethrum products against both *S. cerealella* and *C. oryzae* on unhusked maize in small bins, the most effective were Pyrenone Grain Protectant and an emulsifiable Pyrenone spray concentrate (11·84 per cent. PB and 1·18 per cent. pyrethrins) diluted 1 : 9, both at twice the standard dose, but the protection afforded was inadequate. On husked maize in steel drums, the spray concentrate (1 : 9) at the standard dose gave good protection against both pests for seven months and was the best of the pyrethrum products, but lindane at 3 gm. per cwt. gave complete protection for 11 months; observations indicated that immature stages inside the grains were not affected by lindane, but that the adults died without leaving the kernels. The Pyrenone concentrate (1 : 9) and Pyrenone Grain Protectant, both at the standard dose, protected shelled maize from *C. oryzae* for seven months, and the concentrate at twice and three times the standard dose protected it for 11 months. In a well constructed crib, treatment with Pyrenone Grain Protectant at the standard dose reduced the percentage of unhusked maize infested at the end of 11 months from 52·4 to 16.

Unhusked rice subjected to infestation by *S. cerealella* and *R. dominica* appeared to be better protected by dusts than by emulsion or wettable-powder sprays of the pyrethrum products, possibly because the husks absorb much of the liquid and so prevent a concentration of deposit on the surface, but all gave good protection for seven months when applied at the standard dose. Pyrenone Grain Protectant at twice the standard dose was the most effective, giving good protection for 10–11 months, and lindane at 3 gm. per cwt. gave practically complete protection throughout the period. Lindane caused no tainting of rice or maize or of the eggs of hens fed on treated maize.

Roan (C. C.) & Maeda (S.). **The Cholinesterase of the Oriental Fruit Fly and its *in Vitro* Reactions with various insecticidal Compounds.**—*J. econ. Ent.* **46** no. 5 pp. 775–779, 2 graphs, 16 refs. Menasha, Wis., 1953.

The following is largely based on the authors' conclusions. An investigation of the characteristics of the brain cholinesterase of *Dacus dorsalis* Hend. and of its reaction with eight inhibitors that are used as insecticides indicated that this enzyme is specific for acetylcholine, being inhibited by excess substrate and hydrolysing this ester more rapidly than acetyl-β-methyl choline or benzoyl choline, and that the optimum temperature for cholinesterase activity *in vitro* is approximately 37°C. [98·6°F.]; higher temperatures tend to inactivate the enzyme irreversibly. The anticholinesterase action *in vitro* of paraoxon, parathion, O,O-diisopropyl O-p-nitrophenyl thiophosphate and EPN (ethyl p-nitrophenyl thionobenzenephosphonate) proved to be similar to that reported for the house-fly [*Musca domestica* L.] [*cf. R.A.E.*, A **39** 174–175]. The prior addition of substrate gave considerable protection against the action of all the inhibitors, and the simultaneous addition of substrate and inhibitor also reduced the effectiveness of the latter. Suboptimal temperatures appeared to have relatively little effect when the inhibitors were added first, but when the substrate was added first, the combination of the protective effects of the substrate and the suboptimal temperatures resulted in a marked reduction in inhibitory activity for parathion, diisopropyl p-nitrophenyl phosphate, O,O-diisopropyl O-p-nitrophenyl

thiophosphate, EPN and tetraethyl pyrophosphate. Paraoxon and tetraethyl dithiopyrophosphate were affected less, and 3-methyl-1-phenyl-pyrazolyl(5) dimethylcarbamate [Pyrolan] least. Pyrolan, although representing a different class of chemicals [*cf.* **41** 134], was as effective an anticholinesterase agent as paraoxon or parathion.

Hastings (E.) & Pepper (J. H.). **Further Contributions to Alfalfa Weevil Studies.**—*J. econ. Ent.* **46** no. 5 pp. 785–788. Menasha, Wis., 1953.

As estimates of the reduction in lucerne forage yields caused by the alfalfa weevil [*Hypera variabilis* (Hbst.)] in the United States are largely conjectural, investigations were carried out in one dry and seven irrigated fields in Yellowstone County, Montana, in 1952. Control measures were applied to half of each at or before the appearance of the new spring growth, after which the whole of each field received the same cultural treatment, though the second cutting was delayed for up to 16 days on the untreated half in some cases. Three cuttings were obtained in most of the irrigated fields, and where individual yields could be measured, some degree of damage was evident at every cutting. Populations of larvae were high and relatively uniform throughout most of the test area at the first cutting, but the total reductions in yield in untreated plots varied from 15 to 47 per cent. In all but two fields, feeding on the leaves by the larvae was evident at the second cutting and loss of yield was considerable, even though cutting was carried out at the same stage of growth on treated and untreated plants. The results indicated that *H. variabilis* causes economic loss, regardless of cultural practices, and the most productive fields were the most affected.

In tests for pre-season control of the adult weevils, 4, 6 and 8 oz. heptachlor applied by aeroplane in 2 U.S. gals. diesel oil per acre and 4 oz. heptachlor applied from the ground in 8 U.S. gals. emulsion spray per acre at or before the appearance of new growth in spring reduced larval populations just before the first cutting by averages of 86, 95, 91 and 97 per cent., respectively, but the first treatment did not adequately reduce foliage damage.

Wene (G .P.). **Control of the Serpentine Leaf Miner on Peppers.**—*J. econ. Ent.* **46** no. 5 pp. 789–793, 4 refs. Menasha, Wis., 1953.

Leaf-miners referred to as *Liriomyza subpusilla* (Frost) became increasingly numerous in the Lower Rio Grande Valley of Texas after 1947 and were of major importance on peppers [*Capsicum*] and some other crops by 1952. Experiments on their control on peppers were carried out in 1950–52. In 1950, dusts were applied with hand rotary dusters at about 20 lb. per acre on 9th, 16th and 20th or 16th and 23rd November; 2·5 per cent. aldrin or dieldrin gave the best control, reducing the percentage of leaves infested by about two-thirds, 1 per cent. EPN [ethyl p-nitrophenyl thionobenzene-phosphonate] or parathion and 1·5 per cent. Metacide [methyl-parathion with a smaller quantity of parathion] were slightly less effective, and 20 per cent. toxaphene and 5 per cent. heptachlor were superior to 5 per cent. chlordane; 3 per cent. γ BHC was less effective than chlordane, and two applications of 5 per cent. DDT permitted an increase in infestation. In 1951, when dusts were applied at 20 lb. per acre on 4th, 11th, 18th and 25th September, the percentage of infested leaves was lower after treatment with 2·5 per cent. aldrin or dieldrin, 20 per cent. toxaphene or 5 per cent.

chlordane than after no treatment and higher after 5 per cent. DDT, DDD (TDE) or p,p′methoxy-DDT (methoxychlor).

In 1952, dusts were applied at about 30 lb. per acre on 6th, 8th, 12th, 22nd, 26th and 29th September, with six inches of rain intervening on 15th September, and 2 per cent. parathion, 2·5 per cent. aldrin or dieldrin and 20 per cent. toxaphene all reduced the percentage of infested leaves and increased the average number of pods per plant, parathion being particularly effective. When 2 per cent. parathion and 2·5 per cent. aldrin or dieldrin were applied four times at intervals of a week or eight times at intervals of about 3–4 days in September and October 1952, parathion was more effective than aldrin or dieldrin applied at the same interval and was outstanding when applied twice a week, but aldrin and dieldrin applied twice a week were more effective than parathion applied once. In spray applications in 100 U.S. gals. water per acre on 5th, 8th, 12th, 22nd, 26th and 29th September, 0·5 lb. EPN caused the greatest reduction in infested leaves and increase in number of pods, 0·4 lb. Metacide was almost as good, and 0·2–0·4 lb. Systox [O,O-diethyl O-2-(ethyl mercapto)ethyl thiophosphate (demeton)] (applied only on 5th, 22nd and 29th September) fairly effective, whereas 0·5–1 lb. aldrin, 0·4 lb. dieldrin, 2 lb. toxaphene and 0·5 lb. CS-708 [a 1 : 2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] gave considerably less control.

An unidentified species of *Derostenus* was found parasitising *L. subpusilla* on cowpeas, peppers and cantaloupes, but did not control it.

Medler (J. T.) & Albert (A. R.). **The Relationship between Populations of Alfalfa Insects and Soil Treatments with Boron.**—*J. econ. Ent.* **46** no. 5 pp. 793–797, 1 fig., 5 refs. Menasha, Wis., 1953.

The following is based on the authors' introduction and conclusions. Much of the lucerne grown in Wisconsin lacks sufficient available boron, and as a result shows symptoms that may be confused with those due to attack by *Empoasca fabae* (Harris). The effect on insect populations on the plants of top-dressing the soil in the spring with fertiliser borate at the rate of 40 lb. per acre was therefore investigated in 1950–52. No statistically significant differences were found in the insect populations on treated and untreated plots, and it is concluded that *Adelphocoris lineolatus* (Goeze), *A. rapidus* (Say), *Lygus lineolaris* (P. de B.) (*oblineatus* (Say)) and *E. fabae* are neither attracted nor repelled by borate treatments. On sandy soils, lucerne treated with borate and insecticide made better growth, was greener, blossomed more freely and produced more seed than untreated lucerne. The beneficial effect of boron was associated with soil moisture, being more pronounced under drought conditions, and was masked where infestations of *E. fabae* were allowed to develop. Control of injurious insects had little value in seed production where boron deficiency was uncorrected. It is concluded that an adequate boron supply and the correct use of insecticide are essential for the production of lucerne seed on the sandy and sandy-loam soils of Wisconsin.

Alpert (M.). **Substitution of Malathion for Malathon as a coined (generic) Name for the insecticidal Chemical O,O-Dimethyl Dithiophosphate of Diethyl Mercaptosuccinate.**—*J. econ. Ent.* **46** no. 5 p. 797. Menasha, Wis., 1953.

On 27th March 1953, the Interdepartmental Committee on Pest Control approved the name malathion for the insecticidal chemical previously named

malathon [*cf. R.A.E.*, A **41** 3]. The change was necessary because of difficulty in the trade-marking of the earlier name.

HUFFAKER (C. B.) & KENNETT (C. E.). **Developments toward biological Control of Cyclamen Mite on Strawberries in California.**—*J. econ. Ent.* **46** no. 5 pp. 802–812, 7 figs., 11 refs. Menasha, Wis., 1953.

Valuable control of *Tarsonemus pallidus* Banks, the most important pest of strawberry in California, is given by predacious mites of the genus *Typhlodromus* that may be *T. reticulatus* Oudm., *T. cucumeris* Oudm., or both [*cf. R.A.E.*, A **39** 383; **42** 99] and are here referred to as *T. reticulatus*. Nesbitt considers that *T. reticulatus* may be conspecific with *T. cucumeris*. They are much more effective than *T. occidentalis* Nesbitt, but are destroyed by the treatments with tetraethyl pyrophosphate (TEPP) applied against *Tetranychus bimaculatus* Harvey in spring and early summer. Investigations to assess the effectiveness of *Typhlodromus reticulatus* and to find an acaricide for use against *Tetranychus* that would be harmless to it were carried out in 1950–52, and the following is based largely on the authors' summary of the work.

The investigation included observations on 20 pairs of field plots in second-, third- and fourth-year plantings, of which one of each pair contained predators and the other was kept free of them by treatment with parathion [*cf.* **42** 99], a longer-term study of populations on greenhouse strawberries, and a test in which the predators were removed by hand. The field-population studies gave consistent results and showed conclusively that *Typhlodromus reticulatus* exerts very effective control in third- and fourth-year fields when its activity is not inhibited by chemical treatments. Control in second-year fields was somewhat erratic, probably owing to the lag in appearance of the predators and to the more vigorous treatments applied to the second-year crop. The greenhouse test confirmed the field results and demonstrated the ability of the predator to prevent *Tarsonemus* from increasing above a low level, and hand removal of the predators resulted in increases in *T. pallidus* similar to those due to parathion treatment, indicating that parathion did not in itself favour an increase of *T. pallidus*.

In the tests of acaricides, Genite [2,4-dichlorophenyl benzenesulphonate] and Systox [O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate] were applied as sprays and TEPP, parathion, Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] and Ovotran [p-chlorophenyl p-chlorobenzenesulphonate] as dusts. Genite had little damaging effect on *Typhlodromus reticulatus*, but showed signs of affecting fruit flavour, and it appeared that recovery after treatment with TEPP might be fairly rapid unless repeated applications were made. All the other materials markedly reduced the predators.

DROOZ (A. T.). **Larch Sawfly Investigations in Minnesota, 1952.**—*J. econ. Ent.* **46** no. 5 pp. 826–828, 4 refs. Menasha, Wis., 1953.

Pristiphora erichsonii (Htg.) has required artificial control on larch in Minnesota since 1935, but infestations remained light or scattered until about 1945, when populations began to increase considerably, resulting in 1949 in an outbreak that caused severe defoliation over most of the north of the state. Adults were found from 22nd May to 25th July in 1952. The eggs are laid in the tender new shoots, which curl as a result of the injury, and hatch in about eight days. The larvae of all five instars feed gregariously, preferring the needles of the older shoots, and after 15–21

days drop to the ground and spin cocoons in the debris, but do not enter the soil. They overwinter, some remaining in diapause for over a year, and pupation occurs at any time in late spring or early summer; the pupal stage has been stated to last 8–14 days. Records based on 517 cocoons showed that adult emergence reached its peak on 15th June, rearing experiments that the fifth instar was attained after a feeding period of 10–16 days, and collection of frass that frass production reached a peak between 27th June and 4th July. Examination of infested branches indicated that if natural factors are not sufficient to affect the abundance of the pest and if about 20 per cent. of the new shoots show oviposition injury, complete defoliation may be expected, whereas if only 5 per cent. are attacked, defoliation may reach only 30 per cent. On 26th June, there were 31–699 larvae per branch in a plot that was completely defoliated and 0–119 on one on which defoliation did not exceed 29 per cent.

Dissection of cocoons showed that the Ichneumonid, *Mesoleius aulicus* (Grav.) (*tenthredinis* Morl.), the Tachinid, *Ptychomyia selecta* (Mg.) (*Bessa harveyi* (Tns.)), and the Pteromalid, *Tritneptis klugii* (Ratz.), of which the first is an introduced species, are the three most abundant parasites of *Pristiphora erichsonii* in northern Minnesota. Of 155 cocoons collected at Aurora, nine contained larvae of *Ptychomyia selecta*, 32 contained encapsulated eggs of *M. aulicus*, and 5 contained larvae of *M. aulicus*, indicating that the host is showing resistance to the latter [*cf. R.A.E.*, A **39** 435]. Rodents, insect predators and unfavourable weather destroy large numbers of *Pristiphora* larvae, rain being probably the most important control factor.

Mistric jr. (W. J.) & Rainwater (C. F.). **Further Studies of the Action of Insecticides on Cotton Insects.**—*J. econ. Ent.* **46** no. 5 pp. 838–844, 2 graphs, 5 refs. Menasha, Wis., 1953.

The following is substantially the authors' summary. Laboratory experiments with dusts were continued at College Station, Texas, in 1949–50 by the same techniques as before [*cf. R.A.E.*, A **39** 241] to determine the manner in which various insecticides kill cotton pests, the test insects being larvae of *Anthonomus grandis* Boh., *Alabama argillacea* (Hb.) and *Heliothis armigera* (Hb.), and adults of *Psallus seriatus* (Reut.) and *Hymenarcys nervosa* (Say). The results showed that BHC, aldrin, dieldrin, chlordane, CS-674A [1,1-bis (p-chlorophenyl)-2-nitrobutane] and CS-645A [1,1-bis(p-chlorophenyl)-2-nitropropane] killed the chewing insects by a combination of stomach, contact and fumigating effects, whereas DDT, toxaphene and parathion killed only by a combination of stomach and contact action. The sucking insects were killed either by a combination of contact and fumigating effects or by contact only. Some insecticides were principally stomach poisons and others principally contact poisons, but in each instance the type of effect produced varied to a large extent with the species of insect. There appeared to be no correlation among the types of effect produced, an insecticide acting by contact not always having a fumigating effect.

Dieldrin and parathion were so effective as contact poisons that certain chewing insects were killed by them before they could feed, but these insects were also killed if allowed to feed on treated food without actually being in contact with the insecticides. At the minimum dosages recommended for cotton-insect control, most insecticides killed the chewing insects by a combination of stomach and contact action, but as the dosages were

increased, the contact effect increased and feeding by the insects was reduced.

Dicke (R. J.), Ihde (K. D.) & Price (W. V.). **Chemical Control of Cheese Mites.**—*J. econ. Ent.* **46** no. 5 pp. 844–849, 2 refs. Menasha, Wis., 1953.

The following is taken largely from the authors' summary. Several proprietary acaricides and fungicides, mineral and vegetable oils and glycerine were tested for the control of the mites, *Tyroglyphus farinae* (Deg.) (*Acarus siro*, auct.), *Tyrophagus castellanii* (Hirst), *Glycyphagus domesticus* (Deg.) and *Acotyledon* (*Eberhardia*) *pedispinifer* (Nesbitt) on cheese in Wisconsin. Of the proprietary compounds tested, an aqueous solution of the sodium salt of O-phenylphenol was the only effective product suitable for industrial use. Sprays at a concentration of 0·25 per cent. effectively controlled active mites on cheese or container surfaces, but an aqueous dip containing 4 per cent. of this salt and conditioned with 0·5 per cent. of a gelatine spreader was required for effective control of eggs, resting forms and mites protected in crevices or under wax. The effect lasted three weeks on filter paper but only one week on cheese. Dusts were more effective than sprays in repelling mites on smooth wood surfaces. Residual surface deposits of the salt on treated cheese were not excessive in view of its low mammalian toxicity, and little or no effect was observed on the quality of processed and natural cheese. Wiping lightly infested blocks of cheese with mineral oil or cotton-seed oil and dipping heavily infested blocks in mineral or cotton-seed oil or glycerine for ten seconds resulted in effective control. Mineral oil killed an average of 78 per cent. of the eggs, and cotton-seed oil and glycerine 84 per cent.

Westlake (W. E.) & Butler (L. I.). **Residues of Malathon on Fruits and Vegetables.**—*J. econ. Ent.* **46** no. 5 pp. 850–852. Menasha, Wis., 1953.

Malathion has shown promise for the control of many insects and mites and has a comparatively low toxicity to warm-blooded animals, and a comprehensive study of residues and rates of weathering, begun at Yakima, Washington, in 1951, showed that deposits of it are lost very rapidly from fruits and vegetables. On apples sprayed with 5–20 oz. technical malathion per 100 U.S. gals. in an emulsion spray or 5–12 oz. in a wettable-powder spray on 23rd or 26th July, 31st August or 1st September 1951, residues were less than 0·5 part per million after 14 days, on pears sprayed with 5–15 oz. per 100 U.S. gals. in an emulsion or 5–8 oz. in a wettable-powder spray on 23rd July 1951 or 22nd July 1952, they were less than 0·1 p.p.m. after 14 days, and on apple leaves sprayed with 8 oz. per 100 U.S. gals. they were less than 0·1 p.p.m. after 13–16 days. On peaches treated with 5–10 oz. technical malathion per 100 U.S. gals. in an emulsion or 10 oz. in a wettable-powder spray, initial deposits were high and residues 1·2 and 1·3 p.p.m. after 14 days but less than 0·1 p.p.m. at harvest. When vegetables were dusted with 5 per cent. malathion in 1951 or 1952, snap beans, cucumbers and broccoli receiving 3·75, 7·75 and 2·5 lb. technical malathion per acre, respectively, showed less than 0·1 p.p.m. after six days, and spinach, which received 9·75 lb. per acre and had a very high initial deposit, showed about 4 p.p.m. after six days but less than 0·1 p.p.m. after 12 days.

Douglas (W. A.) & Eckhardt (R. C.). **The Effect of Nitrogen in Fertilizers on Earworm Damage to Corn.**—*J. econ. Ent.* **46** no. 5 pp. 853–854, 1 ref. Menasha, Wis., 1953.

The results are given of experiments carried out in Mississippi in 1945, 1949 and 1950 in which maize grown in plots receiving different amounts of nitrogen in fertiliser was examined for damage caused by the feeding of *Heliothis armigera* (Hb.) and the damage rating was compared with the yield and protein content of the maize. Nitrogen was applied at 0–60 lb. per acre in the drill before planting, and additional nitrogen as a side dressing in some plots when the maize was about 20 in. high. In 1945, no differences in damage rating could be related to levels of 0–80 lb. nitrogen per acre, but in two localities in 1949 and 1950 both the percentage infestation and the damage were greater in plots receiving no nitrogen and producing only small poorly developed ears than in plots supplied with nitrogen and yielding more and better maize; in plots receiving sufficient nitrogen to develop normal ears (60–160 lb. per acre), the amount applied did not significantly affect the degree of damage. In a third locality in which tests were made in 1949 and 1950, there was a slight indication that damage was greater in maize receiving the lowest and highest rates of nitrogen (0 and 120 lb. per acre) than in those receiving 60 lb., whereas yield and protein content increased with the amount of nitrogen supplied.

Schopp (R.), Brindley (T. A.) & Hinman (F. G.). **Field-plot Comparisons of Insecticides for Control of the Pea Weevil.**—*J. econ. Ent.* **46** no. 5 pp. 860–863, 1 ref. Menasha, Wis., 1953.

A 1 per cent. rotenone dust was used to control *Bruchus pisorum* (L.) on peas in Idaho before 1945, but a dust of 5 per cent. DDT subsequently proved more effective. In the tests described, other insecticides, applied in dusts used at 20 lb. per acre unless otherwise stated, were compared with these. A BHC dust containing 1 per cent. γ isomer was about as effective in reducing Bruchid populations and the percentage of peas injured at harvest as rotenone in 1946, and one containing 2 per cent. γ isomer equalled DDT in 1947, but BHC has not been recommended because of its effect on the flavour of the canned peas. In 1946, 3 per cent. chlordane killed the Bruchid more slowly than rotenone, but equalled it in eventual control, as indicated by the infestation in harvested peas, and in 1949, there were no significant differences between 5 per cent. chlordane and 5 per cent. DDT applied at 20 or 40 lb. per acre. In tests in 1946–51, 2·5–5 per cent. p,p′methoxy-DDT (methoxychlor) was about as effective as DDT at the same strengths when applied at 10–40 lb. per acre.

Parathion was tested in 1948–52. At 1 per cent., it did not differ significantly from 5 per cent. DDT at 10 or 40 lb. per acre; 0·25 and 0·5 per cent. parathion controlled the Bruchid as effectively, but permitted significantly more damage at harvest, and 1 per cent. parathion did not differ significantly from 2·5 per cent. DDT in 1952. In 1949, 5 per cent. aldrin, 5 per cent. dieldrin and 10 per cent. toxaphene were as effective as 5 per cent. DDT when used at 20 or 40 lb. per acre, and in 1950 and 1951, 5 per cent. Q-137 [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] in talc did not differ significantly from 5 per cent. DDT when used at 10 or 20 lb. per acre; 2·5 per cent. Q-137 in talc was less effective than 2·5 per cent. DDT in one experiment in 1952 but equal to it in another.

A dust containing 1 per cent. endrin [*cf. R.A.E.*, A **41** 268, note], used at 10 lb. per acre, equalled DDT in controlling the Bruchid and in reducing

damage at harvest in 1951, and 2·5 per cent. malathion in pyrophyllite was significantly less effective than 2·5 per cent. DDT but not than 1 per cent. parathion in one test, whereas all three materials gave almost complete kill in five days in another in 1952.

Babers (F. H.). **Chemical Control and Resistance to Insecticides by agricultural Pests.**—*J. econ. Ent.* **46** no. 5 pp. 869–873, 18 refs. Menasha, Wis., 1953.

Instances are cited of the development of resistance to chemicals used for their control in insects and other arthropods that are pests of plants, as well as those of medical or veterinary importance. Most are from the literature [*cf. R.A.E.*, A **32** 115; **39** 313; **41** 86], but an unpublished report of the development of resistance to DDT in *Scutigerella immaculata* (Newp.) at a place in Indiana is included, 25 lb. DDT per acre being required for satisfactory control whereas 4·5 lb. had previously sufficed. It is considered that further increases in resistance to some of the newer insecticides must be expected and that cultural, ecological and biological means are more likely to give final control than any insecticide that may be developed.

Wolfe (H. R.) & Anthon (E. W.). **Effect of Spray Programs in Cherry Orchards on two Leafhopper Vectors of the Western X-Disease Virus in Washington.**—*J. econ. Ent.* **46** no. 5 pp. 873–876, 2 refs. Menasha, Wis., 1953.

The virus of Western X-disease, which causes a serious disorder of peaches and cherries [*cf. R.A.E.*, A **39** 399], is now known to be transmitted by four Jassids, of which *Colladonus geminatus* (Van D.) and *Scaphytopius acutus* (Say) are the commonest in the stone-fruit orchards of central Washington. They thrive particularly on lucerne, but are often found on the trees, especially where lucerne is used as a cover crop, a high population of the vectors on the cover crop being generally correlated with large numbers feeding in the trees. Slight reductions in population were observed in 1947–52, possibly owing to the increased use of organic insecticides, and the effect of these was investigated in 1952.

Sprays of 1 lb. 25 per cent. wettable parathion were applied in a sweet-cherry orchard on 19th May against *Tortrix (Archips) argyrospila* (Wlk.) and on 4th and 17th June and 28th July against *Rhagoletis cingulata* (Lw.) and an emulsion spray of 0·5 U.S. pint 20 per cent. TEPP (tetraethyl pyrophosphate) on 1st July against *R. cingulata*, by an air-blast machine that also sprayed the lucerne cover crop, and sweeps were made in the latter at intervals from 29th May until 14th October. Comparison with an unsprayed orchard showed that *C. geminatus* was less abundant in the treated one throughout the season, except for the usual period of low population in the whole of the area in August. Parathion gave good control of the Jassid, but populations increased again when its toxicity had been lost; the poor persistence of TEPP apparently allowed a slight increase before the next spray was applied.

When adults were caged on branches of cherry just before treatment, the parathion spray caused 98 per cent. mortality of *C. geminatus*, one of 3 lb. 50 per cent. wettable p,p′methoxy-DDT (methoxychlor) per 100 U.S. gals. 97 per cent. kill of *C. geminatus* and 96 per cent. of *S. acutus*, and the TEPP spray 99 per cent. kill, all in 24 hours; all gave complete mortality in 48 hours, and there was the expected mortality of about 4–25 per cent.

in untreated cages. When the Jassids were caged over cherry branches treated ten days previously with the parathion spray, there was 100 and 96 per cent. mortality of *C. geminatus* and *S. acutus*, respectively, in six days. Counts made in the lucerne cover crop before and after spraying with parathion showed that although control was good, *C. geminatus* began to move back into the treated plots in 48 hours.

Stitt (L. L.) & Allmendinger (D. F.). **Spittlebug and Omnivorous Leaf Tier in Strawberries.**—*J. econ. Ent.* **46** no. 5 pp. 876–878, 3 refs. Menasha, Wis., 1953.

Philaenus leucophthalmus (L.) and *Cnephasia longana* (Haw.) require control on strawberry in south-western Washington, and investigations were therefore carried out in 1949, 1951 and 1952. Nymphs of *P. leucophthalmus* usually appeared just before early blossom development, and spittle masses were most abundant when the earliest fruits were ripe but had disappeared by mid-harvest. The larvae of *C. longana* attack the leaves in early spring and many complete their feeding in the fruits under the calyx; they had usually finished feeding in the fruits by the third picking.

In 1949, dusts were applied on 19th April and 14th May, the total amounts being 71 lb. for 1 per cent. parathion, 72 lb. for a mixture of 5 per cent. DDT and 25 per cent. sulphur, and 75 lb. for 5 per cent. DDD (TDE); 5 per cent. chlordane was used in a preliminary test. They reduced the average numbers of spittle masses per crown from 11·22 for no treatment to 7·03, 1·93, 1·57 and 0·05, respectively, and the numbers of larvae (or tunnels) of *C. longana* per 100 fruits from 1·22 for no treatment to 0·13, 0·05, 0·098 and 0·78, respectively. Further materials were tested in 1951, but spittle masses had disappeared before examinations were made, and infestation by *C. longana* was too low for the results to be interpreted. In 1952, dust applications of 44 lb. 0·75 per cent. rotenone, 42 lb. of a mixture of 5 per cent. DDT and 1 per cent. parathion, 42 lb. 5 per cent. chlordane, 46 lb. 5 per cent. toxaphene, 38 lb. 5 per cent. DDD, and 42 lb. 5 per cent. p,p′methoxy-DDT (methoxychlor) per acre on 1st May reduced the mean number of spittle masses counted on 25 crowns per plot on 14th May from 78·53 to 13·42, 13·19, 4·25, 3·62, 19·66 and 12·17, respectively, and the mean number on ten crowns per plot on 29th May from 30·63 to 12·17, 8·5, 4·38, 0·89, 11·82 and 5·8, respectively. Measuring infestation by the number of masses found in 30 seconds by two observers made no difference to the accuracy of the results. Infestation by *C. longana* was again too low for adequate tests. Strawberries treated with 42 lb. 5 per cent. chlordane per acre were found to bear residues of 0·015–0·019 part per million.

King (D. R.) & Weaver (C. R.). **The Effect of Meadow Management on the Abundance of Meadow Spittlebugs.**—*J. econ. Ent.* **46** no. 5 pp. 884–888, 2 graphs, 11 refs. Menasha, Wis., 1953.

Data obtained in meadows of lucerne or clover of varying ages in northern Ohio showed that movements of adults of *Philaenus leucophthalmus* (L.) depend largely on the availability of succulent foliage. Meadow management in autumn determines the attractiveness or unattractiveness of the fields as feeding sites. Procedures that promote the growth of succulent foliage in newly sown clover and lucerne or in old stands of lucerne during early September, immediately before and during the oviposition period of *Philaenus*, result in increased adult populations and subsequent large infestations of nymphs in the following spring, whereas fields, such as those

grazed through the season, those cut in early September and those sown during the summer, in which there is no luxuriant foliage, will have lower populations.

It is doubtful whether practical control over an area can be achieved by cultural manipulation, but a study of the relation of management practices to the period of egg formation and oviposition helps to explain the differences in nymphal populations found in meadows of varying ages in the different areas in which *P. leucophthalmus* is a pest.

Grayson (J. M.). **Selection of the Large Milkweed Bug through seventeen Generations for Survival to sublethal Concentrations of DDT and Toxaphene.**—*J. econ. Ent.* **46** no. 5 pp. 888–890, 1 graph, 8 refs. Menasha, Wis., 1953.

The following is largely the author's summary. Strains of *Oncopeltus fasciatus* (Dall.) were reared in the laboratory through 17 generations in each of which they were exposed to treatment with DDT or toxaphene. The criterion of selection was survival after dipping treatments that gave 50 per cent. kill or more. The procedure employed in treating the insects is described.

In the 17th generation, 3·7 times as much DDT and 1·8 times as much toxaphene were required to kill 50 per cent. of selected as of unselected adults. No specific comparisons were made between strains at high mortalities, but the data indicated that the DDT-selected strain was less resistant at high mortality points than at the median lethal dosage and that the toxaphene-selected strain had almost no resistance to toxaphene at concentrations causing 87 per cent. or more kill. No significant differences were found between selected and unselected strains in the numbers of eggs produced per female per day.

The results of preliminary tests in which six generations of *O. fasciatus* were exposed to aldrin indicated that concentrations in the upper part of the sublethal range exert a deleterious effect on reproduction.

Michelbacher (A. E.) & Bacon (O. G.). **Systox on Walnuts in northern California.**—*J. econ. Ent.* **46** no. 5 pp. 891–893, 1 fig. Menasha, Wis., 1953.

Various insecticides were combined with a spray of wettable DDT, applied on 10th May with a speed sprayer (capacity at least 43,000 cu. ft. per minute) against the codling moth [*Cydia pomonella* (L.)], for the control of *Cromaphis juglandicola* (Kalt.) on walnuts in California. Systox (O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate [demeton]) at 0·62, 1·25, or 2·5 lb. actual compound per acre gave excellent control of the Aphid, permitting no colonisation on the old foliage until late in the season, though migrating adults were able to establish colonies on new foliage by early summer. It was much more effective than 1 lb. 25 per cent. wettable parathion, 2 lb. 25 per cent. wettable malathion, 3 lb. 25 per cent. wettable EPN-300 [ethyl p-nitrophenyl thionobenzenephosphonate], 7 lb. 14 per cent. nicotine dry concentrate or 7 lb. BHC (6 per cent. γ isomer) per acre, applied on the same date and followed by similar applications of 1·1 lb. 25 per cent. parathion, 0·27 lb. parathion in a liquid concentrate, 2·2 lb. 25 per cent. malathion, 0·55 lb. malathion in an emulsion concentrate, 3·3 lb. 25 per cent. EPN or 7·7 lb. 14 per cent. nicotine per acre on 30th June, though all these gave initial control. Malathion appeared to give little protection and was also the only material to permit the development of mites, mainly

Tetranychus pacificus McG., and to result in nuts of poor quality. Systox gave nuts of high quality, particularly on the northern side of the trees, despite the fact that the highest dosage caused foliage injury there, and the other treatments also resulted in nuts of good quality. Systox caused little or no foliage injury at the lowest rate, and no changes in flavour were detected in nuts from trees treated at any of the three.

Frick (K. E.). **Inspection Methods to detect Cherry Fruit Fly Larvae in Cherries.**—*J. econ. Ent.* **46** no. 5 pp. 893–894, 5 refs. Menasha, Wis., 1953.

In a comparison of five methods of detecting the degree of infestation of cherries by *Rhagoletis cingulata* (Lw.) in Washington State in 1950 and 1951, newly picked fruits that were thought to be infested but showed no breathing holes were split open immediately, cooked and mashed immediately, held on concentrators over soil, stored in paper bags for seven days and split, or stored for seven days, cooked and mashed. The results showed that counts of the larvae made immediately after picking do not reveal the potential infestation, but that keeping the fruits for seven days allows the development of maximum numbers, since the eggs hatch in 5–8 days at room temperature. Ripe cherries kept for longer than seven days rapidly decay. Cooking and mashing did not appear to be superior to splitting, and there was difficulty in separating the larvae from the fruit fragments after cooking.

Newcomer (E. J.) & Dean (F. P.). **Control of Orchard Mites Resistant to Parathion.**—*J. econ. Ent.* **46** no. 5 pp. 894–896, 1 ref. Menasha, Wis., 1953.

The authors record the development of resistance to parathion in *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi*, auct.), *Tetranychus pacificus* McG. and *T. mcdanieli* McG. in apple orchards in the Pacific North-west of the United States that had received repeated applications of parathion sprays for two or more seasons [*cf. R.A.E.*, A **41** 208]. Tests were made in 1952 in two orchards, in one of which 4 oz. 15 per cent. parathion per 100 U.S. gals. had proved effective against *T. pacificus* in 1948. Sprays were applied in June, mid-July and early August, and it was found that 1 lb. 15 per cent. parathion per 100 U.S. gals. failed to control any of the species when used alone, though 8 oz. 15 per cent. parathion with 0·5 U.S. pint 25 per cent. DMC [1,1-bis(p-chlorophenyl)ethanol] per 100 U.S. gals., applied in August, controlled *P. pilosus* and *T. mcdanieli*. Sprays of 2 lb. 25 per cent. malathion, 1 lb. 27 per cent. EPN [ethyl p-nitrophenyl thionobenzenephosphonate], 6 oz. 42 per cent. Systox [O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate (demeton)], 1 lb. 15 per cent. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], 3 lb. 50 per cent. R-242 [p-chlorophenyl phenyl sulphone] or 1·5 lb. 50 per cent. p-chlorophenyl p-chlorobenzenesulphonate per 100 U.S. gals. all controlled *T. pacificus* well and *P. pilosus* and *T. mcdanieli* so well that the August application was not necessary. *T. mcdanieli* increased late in the season more on the trees sprayed with malathion, R-242 and p-chlorophenyl p-chlorobenzenesulphonate than on the others. *P. pilosus* showed more tendency to decline late in the season than *Tetranychus*, because of the progressive deposition of winter eggs, and was controlled better by malathion, Systox, R-242 and p-chlorophenyl p-chlorobenzenesulphonate than by the other materials.

These results and observations in other orchards indicate that to control resistant mites, it may be advisable to use more than one acaricide during the season, either alternately or in combination with parathion.

Simkover (H. G.). *Rhagoletis cingulata* **on wild and cultivated Cherries in eastern Washington.**—*J. econ. Ent.* **46** no. 5 pp. 896–897, 6 refs. Menasha, Wis., 1953.

Since the wild cherries, *Prunus emarginata* and *P. virginiana* var. *demissa*, occur in close proximity to cultivated cherry in eastern Washington, investigations were carried out in 1951–52 on the identity of the fruit-flies of the genus *Rhagoletis* that infest them. The flies from wild cherries had been classified as *R. indifferens* Curr. [*R.A.E.*, A **20** 464], and although later workers considered this a synonym of *R. cingulata* (Lw.) [*cf.* **32** 113, etc.], Phillips concluded from a study of the larvae in a work published in 1946 [**35** 376] that *R. indifferens* was a distinct species. In the investigations, puparia were collected in 1951 from soil beneath *P. emarginata* growing near the type locality of *R. indifferens* and beneath cultivated cherry in a district isolated from wild cherries. The resulting adults were paired in all four combinations, and in each case eggs were laid in the cultivated cherries provided. The puparia were stored over winter, and adults emerged between 24th June and 1st July 1952 and were allowed to pair. The crosses were repeated in 1952 with fresh adults from the same localities. Both cultivated cherries and fruits of *P. emarginata* were supplied for oviposition. Apparently normal larvae resulted from each combination, and all those of the F_1 generation and the great majority of those of the F_2 generation were found in the cultivated cherries.

There was great variation in the adults from *P. emarginata* in the character of the male genitalia on which *R. indifferens* was separated, and a study of larvae collected later from the same tree failed to support Phillips' view that *R. indifferens* is a distinct species. It is thus confirmed that *R. indifferens* is a synonym of *R. cingulata*, and that the species attacking the wild cherries in eastern Washington is the latter.

Although cherry orchards near Wenatchee are free from the fruit-fly, puparia of *R. cingulata* have been sifted from the soil in neighbouring canyons where wild cherries are abundant. These were heavily parasitised by species of *Opius*, and the presence of these parasites may have kept the fruit-fly from spreading to the neighbouring orchards. The recent occurrence of *R. cingulata* in the Wenatchee Valley may be due to a natural decline in parasite numbers in some localities.

Washburn (R. H.). **A Grasshopper Outbreak near Palmer, Alaska 1951.** —*J. econ. Ent.* **46** no. 5 pp. 897–898, 4 refs. Menasha, Wis., 1953.

Although several species of grasshoppers occur in Alaska, they have not hitherto been observed in unusually large congregations or damaging cultivated plants. In late July 1951, however, *Melanoplus mexicanus mexicanus* (Sauss.) caused appreciable damage to market-garden crops, soft fruits and a crop of oats and peas grown for hay on farms near a rock formation south of Palmer. It is concluded from observations in 1952 that the outbreak was the result of unusually warm weather the previous year, which caused rapid maturing of the grasshoppers, early depletion of normal feeding grounds higher on the rock and dispersal to other sources of food.

Sullivan (W. N.) & Hornstein (I.). **Concentrations and Exposure Time of Lindane Vapor required to kill Insects.**—*J. econ. Ent.* **46** no. 5 pp. 898–899, 5 refs. Menasha, Wis., 1953.

Experiments to determine the concentration of lindane [γ BHC] in air and the period of exposure to it necessary to kill various insects were made in a Peet-Grady chamber lined with brown paper in which the vapour was dispersed by passing air through a filter treated with 8·3 gm. lindane [*cf. R.A.E.*, A **40** 351] for at least 24 hours. The temperature of the chamber was maintained at 24 or 30°C. [75·2 or 86°F.]. Adults of *Musca domestica* L. and *Aëdes aegypti* (L.) and large nymphs and adults of *Periplaneta americana* (L.) were exposed in it in wire-mesh cages and adults of *Bruchus* (*Acanthoscelides*) *obtectus* Say and *Tribolium confusum* Duv. in open petri dishes for periods depending on their susceptibility. Determination of the concentration of lindane per litre of air [*cf.* **42** 53] showed that it was 0·6 mmg. at 24°C. and 1·19 mmg. at 30°C. (70 and 65·5 per cent. saturation, respectively), and these gave 99 and 100 per cent. kill of *Aëdes* after exposure for two minutes, 90 and 100 per cent. of *Musca* after ten minutes, 96 and 100 per cent. of *Bruchus* after 30 minutes and only 12 and 67 per cent. of *Tribolium* and 21 and 33 per cent. of *Periplaneta* after 60 minutes. Exposure of *Tribolium* for 180 minutes gave 56 and 88 per cent. mortality and of *Periplaneta* for 240 minutes 48 and 72 per cent.

To avoid possible dispersion of solid particles of lindane as well as vapour in the air, the walls of a closed cabinet were treated with lindane and the cabinet was kept closed until the lindane concentration reached a steady state; 91 per cent. saturation was obtained, and this gave 94 per cent. mortality of *M. domestica* exposed for ten minutes at 27°C. [80·6°F.].

It is concluded that although small flying insects are easily killed with 0·6–1·19 mmg. lindane per litre of air, practical control of *P. americana* and *T. confusum* could probably be obtained only with higher concentrations or longer exposures [*cf.* also **42** 88]. Under practical conditions, concentrations of 0·02–0·2 mmg. per litre effectively controlled small flying insects in long exposure periods, and lindane was deposited in differing degrees on different surfaces to form a toxic residue. It is therefore considered advisable to test a wide range of concentrations of lindane in air and as a residual deposit when evaluating its toxicity to warm-blooded animals.

Lincoln (C.), Williams (F. J.) & Barnes (G.). **Importance of a Thrips in Red Spider Control.**—*J. econ. Ent.* **46** no. 5 pp. 899–900. Menasha, Wis., 1953.

Cotton in eastern Arkansas has for many years been infested by Tetranychid mites. In 1940, about 5 per cent. of the fields in the northern half of the Mississippi delta proper in Arkansas were infested, most attacks originating from vegetation at the edges of the fields [*cf. R.A.E.*, A **30** 133] whereas in 1952, the percentage increased from 1·3 in late June to 18 in late July and infestation apparently spread from green plants that survived the winter in the fields. Widespread use of winter cover crops and unusually low rainfall may have favoured survival. Infestation remained at the peak level for a week and then dropped rapidly, so that less than 1 per cent. of the fields were infested by mid-August. The decrease was due almost entirely to attack by the predacious thrips, *Sericothrips variabilis* (Beach), which was numerous in areas recently infested by the mite. Little insecticide, and that mainly dust containing 40 per cent. sulphur, was applied until mid-August, and this seemed to have had little effect on the

rise or decline of the mite infestation. Rainfall was fairly general at the beginning of August, but observations indicated that the thrips was of greater importance in control.

Acree jr. (F.). **Studies on the Chromatography of Gyptyl Azoate.**—*J. econ. Ent.* **46** no. 5 pp. 900–902, 4 graphs, 4 refs. Menasha, Wis., 1953.

This is a progress report on chromatographic studies made with the object of isolating gyptol, the sex attractant extracted by benzene from the abdominal tips of virgin females of *Lymantria* (*Porthetria*) *dispar* (L.) [*cf. R.A.E.*, A **41** 360].

Pontoriero (P. L.) & Ginsburg (J. M.). **An abridged Procedure in the Schechter Method for analyzing DDT Residues.**—*J. econ. Ent.* **46** no. 5 pp. 903–905, 1 graph, 8 refs. Menasha, Wis., 1953.

The following is the authors' summary. A shortened procedure in the technique of the Schechter colorimetric method for analysing DDT insecticides [*cf. R.A.E.*, A **35** 412] was tested in various formulations and spray residues in comparison with the longer, standard procedure. In the shortened method, the ether extraction of the nitrated mixture is eliminated and only the p,p′isomer content is analysed.

The results indicate that the abridged procedure can be used with approximately the same accuracy as the longer technique in estimating p,p′DDT in various insecticide formulations and in spray residues.

Chao (Yung-chang), Simkover (H. G.), Telford (H. S.) & Stallcop (P.). **Field Infestations of Stored Grain Insects in eastern Washington.**—*J. econ. Ent.* **46** no. 5 pp. 905–907, 2 refs. Menasha, Wis., 1953.

To ascertain whether field infestation by stored-grain insects occurs in eastern Washington, 145 2-lb. samples of the first wheat delivered to the elevators were examined in 1951 and 306 in 1952. Of these, 13 were found to be infested, the insects taken comprising 25 larvae and 4 adults of *Oryzaephilus surinamensis* (L.), two adults of *Calandra* (*Sitophilus*) *granaria* (L.), three of *Tribolium castaneum* (Hbst.), seven of *Laemophloeus minutus* (Ol.) (*pusillus* (Schönh.)), and four of *Trogoderma simplex* Jayne. The evidence indicated that none of these had developed on the standing grain, and the infestations are thought to have originated from combines, trucks or elevators or casual migrants in the field. In a survey of ripe standing wheat in 1951, no stored-grain insects were collected in 40 sweeps with a standard 15-inch insect net in each of 100 fields.

Cressman (A. W.) & Broadbent (B. M.). **Susceptibility of resistant and non-resistant Strains of the California Red Scale to Oil and to Parathion.**—*J. econ. Ent.* **46** no. 5 p. 907, 5 refs. Menasha, Wis., 1953.

Strains of *Aonidiella aurantii* (Mask.) resistant and non-resistant to fumigation with hydrogen cyanide that have been reared in the laboratory in California have been reported to be equally susceptible to oil sprays [*cf. R.A.E.*, A **30** 439; **31** 330], and this finding was confirmed in further tests in 1939–51. In 1939, another stock was separated from the resistant strain and subjected to repeated fumigation in the laboratory with HCN, and the resistance of most stages of this stock to the fumigant was considerably increased [*cf.* **40** 101]. Tests of the susceptibility of this stock and the

unfumigated resistant scales to sprays prepared from various oils and emulsifiers in 1944 and 1951 showed that the former, of which 56 generations had been fumigated by the last date, was consistently more susceptible to oils than the latter, possibly because the repeated fumigation selected a gene or genes, linked with genes for resistance to HCN, that make for less resistance to oils. Spraying the non-resistant, resistant and fumigated resistant scales with 0·7 or 1·4 gm. 25 per cent. wettable parathion per litre in July 1951 revealed no significant differences in susceptibility between the three stocks on examination 52 days later.

Chao (Yung-chang) & DeLong (D. M.). **The Stability of Lindane and Pyrenone impregnated Dusts and their relative Toxicity to the Granary Weevil.**—*J. econ. Ent.* **46** no. 5 pp. 908–910, 5 graphs, 3 refs. Menasha, Wis., 1953.

In small-scale laboratory tests, wheat containing 11·5 per cent. moisture was thoroughly coated with sufficient dust impregnated with lindane [almost pure γ BHC] or Pyrenone O.T.50-5 (containing a 10 : 1 mixture of piperonyl butoxide and pyrethrins) to give dosages of 0·16, 0·8 and 4 parts per million lindane or pyrethrins, respectively, infested with adults of *Calandra* (*Sitophilus*) *granaria* (L.), and kept at a constant temperature of 25°C. [77°F.] and 60–70 per cent. relative humidity. Samples were examined and adult weevils removed after 1–14 days, after which the wheat was returned to the bottles and examined again after three and six months.

At equal doses of lindane and pyrethrins, lindane was more toxic than Pyrenone; at the lowest dose, they gave 50 per cent. and no kill, respectively, in two weeks, and at the second, 100 per cent. kill in one week and 24 per cent. in two weeks, respectively. After three and six months, only grain treated with the two higher doses of lindane or the highest of Pyrenone was free of infestation, the remainder containing dead or living weevils that had apparently developed from eggs laid by the original adults. Tests of the persistence of action of the two materials, made by introducing fresh adults into treated samples that had proved free from infestation after three months, showed that the toxicity of the lindane had decreased considerably, whereas that of the Pyrenone was little affected.

It is concluded that lindane is the more toxic of the two materials and Pyrenone the more persistent, and that lindane at 0·8 p.p.m. and Pyrenone at 4 p.p.m. pyrethrins give complete protection of wheat against *C. granaria* for at least six months.

Klostermeyer (E. C.) & Rasmussen (W. B.). **The Effect of Soil Insecticide Treatments on Mite Population and Damage.**—*J. econ. Ent.* **46** no. 5 pp. 910–912, 1 fig., 1 ref. Menasha, Wis., 1953.

In the course of an experiment in Washington on the effect of gross amounts of insecticide in the soil on plant growth, 10, 24, 119 and 238 lb. technical DDT, 119 lb. purified DDT, 0·5 and 15 lb. lindane [almost pure γ BHC], 3 and 15 lb. crude BHC, 8, 15 and 75 lb. chlordane and 3 and 60 lb. aldrin per acre were applied to a fine sandy loam with a fertiliser spreader in May 1950 and incorporated to a depth of six inches. Several different crops were grown on the treated soil during the next three seasons. *Tetranychus bimaculatus* Harvey became abundant on Black Valentine beans in 1951 and later infested an autumn planting of hairy vetch [*Vicia*], on which it became very numerous in 1952. Potatoes had been planted next to the vetch in June 1952, and the mites migrated to these as the vetch

matured. An application of parathion failed to control them. Potatoes on plots treated with 119 lb. or more DDT per acre were killed by the mites and those on other treated plots were severely damaged, whereas those on adjacent untreated plots remained practically free from injury until harvest, although all plots were infested. The potato plants had made nearly normal growth before the mite infestation and had not been seriously affected by any insecticide but 15 lb. BHC in the previous season. Mite populations on the different plots of potato did not differ significantly when sampled, but there was evidence of increase in numbers as the dosage of insecticide increased, and increases in mite damage were reflected in decreases in yield. Black Valentine beans were beginning to shoot as the potatoes were dying, and counts of the mites on these showed significant differences among treatments and between treatment and no treatment on 15th September, but no significant differences between treatments, except for a significant linear increase in mite numbers with increasing amounts of technical DDT, and significantly fewer mites on untreated than on treated plots on 26th September. Predators are generally rare on beans, and it is unlikely that the differences were due to them. Since all the insecticides adversely affected the growth of some of the crops at high dosages, the differences in mite population were probably due to the effects of the insecticides on plant nutrition and composition [*cf. R.A.E.*, A **40** 386].

Brett (C. H.) & Brubaker (R. W.). **Mexican Bean Beetle Control with Malathon compared with eight other Materials.**—*J. econ. Ent.* **46** no. 5 pp. 912–913. Menasha, Wis., 1953.

As rotenone gives variable control of *Epilachna varivestis* Muls., one of the most destructive pests of beans on the eastern coast of the United States, 11 dust treatments were compared against the beetle in North Carolina in 1952. The dusts were applied four times at 25–30 lb. per acre between 29th May and 23rd June to snap beans planted on 10th May, and surviving larvae were counted on 24th June and larvae and pupae on 3rd July. Malathion at 5 per cent. resulted in almost complete absence of insects on both dates, and 1·5 per cent. parathion, CS-708 [a 1 : 2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] or isodrin [*cf. R.A.E.*, A **41** 268, note] and 5 per cent. p,p′methoxy-DDT (methoxychlor) were also very effective. Inferior results were given by 1 per cent. CS-708 and dusts containing rotenone and sulphur, alone or with pyrethrins, though better results were obtained when a proprietary activator was added to the latter. EPN [ethyl p-nitrophenyl thionobenzenephosphonate] at 1·5 per cent. was of little value.

Fresh or canned snap beans that had been dusted with 25 lb. 5 per cent. malathion per acre on 9th and 24th September and picked on 7th October in North Carolina or dusted with 35 lb. 3 per cent. malathion per acre on 26th September and picked on 2nd October in Virginia contained no residues that could be detected by chemical analysis and were not affected in flavour, and it is concluded that malathion is a promising material for use against *E. varivestis*.

Beckwith (L. C.). **Collection of European Elm Bark Beetles in Wisconsin.**—*J. econ. Ent.* **46** no. 5 p. 913. Menasha, Wis., 1953.

Adults of *Scolytus multistriatus* (Marsh.) were collected from an American elm (*Ulmus americana*) in Wisconsin in September 1952. Entrance holes had been made through the bark, but the absence of gallery

patterns indicated that the attack was in the initial stage. The tree was apparently in a weakened condition, but examination of sawn branches showed that Dutch elm disease [*Ceratostomella ulmi*], which is transmitted by *S. multistriatus*, was not present. The tree was subsequently destroyed. This is the first official record of the bark-beetle in Wisconsin.

Doucette (C. F.). *Amphicyrta chrysomelina* **as a Pest of Lilies.**—*J. econ. Ent.* **46** no. 5 p. 914. Menasha, Wis., 1953.

Larvae of a species of *Amphicyrta* were taken from the soil of a planting of Croft lilies at Harbor, Oregon, in April 1942 and were observed attacking vegetable seedlings in the same area in 1943. They occurred singly in short vertical burrows about two inches deep during the day, and came to the surface at night to feed; they chewed off pieces of leaves from the plants and pulled them into their burrows, with no apparent preference for particular plants. The common occurrence of this Byrrhid in lily plantings indicates that the adults may prefer them for oviposition. One grower reported injury to various seedlings in a greenhouse. Further larvae were collected during the spring of 1947, and adults reared from them were identified as *A. chrysomelina* Erichson. In the same year, applications of undiluted powdered lead arsenate to the soil surface of a heavily infested bed of Easter lilies did not control the larvae, but a 10 per cent. DDT dust arrested feeding immediately and killed most of them in six days. Damage in the lily-bulb producing areas of southern Oregon was subsequently much reduced, possibly owing to the change from lead arsenate to the newer insecticides for use against other insects attacking lilies.

Sakimura (K.). *Frankliniella tritici*, **a Non-vector of the Spotted Wilt Virus.**—*J. econ. Ent.* **46** no. 5 pp. 915–916, 2 refs. Menasha, Wis., 1953.

In further experiments on the potential vectors of the virus of spotted wilt [*cf. R.A.E.*, A **28** 485], carried out in New Jersey in 1948, nymphs of *Frankliniella tritici* (Fitch), collected in the field, and of *Thrips tabaci* Lind., which is a known vector, were allowed to feed on leaves of infected China aster (*Callistephus chinensis*), *Emilia sonchifolia*, broad bean (*Vicia faba*), *Stellaria media*, *Verbena hybrida* or *Zinnia elegans*. When the adults emerged, these were transferred in pairs to healthy plants of these species or nasturtium (*Tropaeolum majus*). The adults of *F. tritici* produced no infection in the 147 plants to which they were transferred, whereas *T. tabaci* infected 70 of 204 test plants. It is concluded that *F. tritici* is not a vector. *T. nigropilosus* Uzel and *Hercinothrips femoralis* (Reut.) also failed to transmit the virus in similar tests [*cf. loc. cit.*], whereas *T. tabaci* and *F. fusca* (Hinds) from the same source plants readily did so.

Jones (S. C.) & Schuh (J.). **Fumigation Tests with Methyl Bromide for the Control of Cherry Fruit Fly Eggs, Larvae and Puparia.**—*J. econ. Ent.* **46** no. 5 pp. 916–917. Menasha, Wis., 1953.

In tests in Oregon in 1941–42, one larva hatched from 106 eggs of the cherry fruit-fly [*Rhagoletis cingulata* (Lw.)] that were laid in Montmorency cherries and fumigated with 2 lb. methyl bromide per 1,000 cu. ft. for two hours at 80°F., though it died soon after, and one hatched from 103 eggs that were treated with 3 lb. methyl bromide for two hours at 74–77°F. and survived; 12 of 34 untreated eggs hatched. In July 1941, small numbers of young larvae but no mature ones survived fumigation with 2–3 lb. methyl

bromide per 1,000 cu. ft. for 2–3 hours in cherries with or without emergence holes. When mature larvae were treated apart from the cherries, three of 20 survived fumigation with 2 lb. methyl bromide for 2–3 hours and none fumigation with 3 lb. for three hours at 67–73°F. In September, fumigation with 2 lb. methyl bromide per 1,000 cu. ft. for 1–4 hours failed to give complete kill of pupae. In 1942, fumigation with 2–3 lb. gave complete kill of pupae when the period of exposure was 24 hours, but not when it was 12.

Hocking (B.). **Larval Nutrition in *Agrotis orthogonia* Morr. (Lepidoptera: Phalaenidae). A new Rearing Method.**—*Canad. J. agric. Sci.* **33** no. 1 pp. 23–29, 2 graphs, 20 refs. Ottawa, 1953.

Larvae of *Agrotis orthogonia* Morr. reared in the laboratory are usually given cut leaves as food [*cf. R.A.E.*, A **16** 267; **35** 108] and their development is as a rule much slower than in the field. In view of their predominantly subterranean habits, the suitability of this type of food was investigated in the laboratory, and the following is based on the author's summary of this account of the work. Whole wheat seedlings were shown to be far superior to cut wheat leaf as a laboratory food for the larvae. This superiority is attributed to the greater food, and especially nitrogen, intake permitted by the greater water content of the former, which results from the ability of the root hairs to absorb water from a moist substratum. Green plant material was not essential for growth. Neither nutrient salts nor 2,4-D [2,4-dichlorophenoxyacetic acid] added to the water used to germinate the seedlings had any significant effect on the growth rate of the larvae. In a discussion of these findings, it is pointed out that in view of the permeability of the cuticle of soil insects to water [*cf.* **34** 60] and the association of *A. orthogonia* with dry conditions [**14** 124], a plentiful supply of water is essential to it, and the larval habit of cutting the stems of plants and utilising the root systems to draw up water from depths to which they could not penetrate is an adaptation to this need.

Slykhuis (J. T.). **Wheat Streak Mosaic in Alberta and Factors related to its Spread.**—*Canad. J. agric. Sci.* **33** no. 2 pp. 195–197, 4 refs. Ottawa, 1953.

Wheat streak mosaic, which appears to be identical with a disease caused by a combination of the yellow and mild streak mosaic viruses that was reported in Kansas in 1932 and has since damaged wheat crops in the Great Plain regions of the United States, was found in southern Alberta for the first time in 1952. The symptoms comprise chlorosis of the leaves or the development of chlorotic streaks running down them, stunted growth, and serious reductions in yield and in the quality of the grain produced. The disease occurred on spring and winter wheat in areas where winter wheat had been grown regularly, and usually only a small percentage of the plants was affected, though infection reached 70–100 per cent. and crop damage was severe in some fields. Injury was heaviest in early-sown winter wheat and late-sown spring wheat growing near a source of infection. The disease spread rapidly through experimental plots during summer and early autumn. It was transmitted by sap, but not through seed or soil or by Aphids, Jassids, thrips or other insects collected from severely infected wheat. Close examination of infected plants, however, revealed the presence of an unidentified Eriophyid of the genus *Aceria*, and when the mites were transferred or allowed to migrate to healthy wheat plants in

pots, the latter developed symptoms resembling those of streak mosaic. In further tests in which mites from infected plants were transferred singly to healthy seedlings growing in sterilised soil in test-tubes plugged with cotton, symptoms developed on several of the seedlings in about seven days. Of a total of 56 plants bearing mites, 43 developed chlorotic symptoms, but streak mosaic could be transmitted to healthy plants by inoculation from only 16. It is therefore concluded that the mites can transmit streak mosaic, but also induce chlorotic symptoms that resemble but are not related to it.

Colhoun (E. H.). **Notes on the Stages and the Biology of** *Baryodma ontarionis* **Casey (Coleoptera: Staphylinidae), a Parasite of the Cabbage Maggot,** *Hylemya brassicae* **Bouché (Diptera: Anthomyiidae).**—*Canad. Ent.* **85** no. 1 pp. 1–8, 5 figs., 10 refs. Ottawa, 1953.

During investigations on the natural enemies of Diptera that attack cultivated crucifers in Canada, *Aleochara* (*Baryodma*) *ontarionis* (Csy.) was reared from puparia of *Hylemyia brassicae* (Bch.). W. J. Brown considers this Staphylinid, all stages of which are described, to be identical with *A. bilineata* Gylh., which attacks *H. brassicae* in Europe [*cf. R.A.E.*, A **37** 141, etc.]. It was readily bred in the laboratory, and at 23·8°C. [74·84°F.] and 75 per cent. relative humidity, the adults survived for about 48 days when larvae of *Musca domestica* L. and *Drosophila melanogaster* Mg. were provided as food. The pre-oviposition period lasted 48 hours. Puparia of *H. brassicae* were provided for the ovipositing females, but the eggs were laid indiscriminately on the moist blotting-paper lining or the sides of the dishes, as well as on the puparia; when copper-coated pellets were placed in the dishes, 95 per cent. of the eggs were laid on or between them, so that it is possible that eggs are normally laid among soil particles. The average number per female was 710, and these were laid throughout life at the average rate of 15 per day. The larva hatched in 3–7 days and gnawed an entrance hole into the host puparium, which was later sealed by the haemolymph of the host, in 12–36 hours; starved larvae survived for an average of 8·7 days, and mortality among them after 36 hours was only 8 per cent. Sometimes several entered the same puparium, but only one larva completed its development on each host. The first instar lasted eight days, except in overwintering examples. Larvae in the second and third instars, which lasted five and six days, respectively, were inactive and fed voraciously on the host pupae, which they consumed completely except for the cuticle. Pupation occurred within the host puparium, and the pupal stage lasted 14 days. The adults also fed on larvae of *H. brassicae*, five of which were consumed by a single individual in one day, and *Agria* (*Pseudosarcophaga*) *affinis* (Fall.). They did not feed on puparia if larvae were available, and they attacked other adults and eggs of their own species in the absence of other food.

Phillips (C. M.), Bucher (G. E.) & Stephens (J. M.). **Note on Preliminary Field Trials of a Bacterium to control the Codling Moth.**—*Canad. Ent.* **85** no. 1 p. 8, 2 refs. Ottawa, 1953.

In a field test in Nova Scotia, artificially established populations of larvae of *Cydia* (*Carpocapsa*) *pomonella* (L.) were sprayed with suspensions of spores of *Bacillus cereus* [*cf. R.A.E.*, A **40** 303]. One suspension was produced after three serial passages through the host and applied at a concentration of $1{\cdot}4 \times 10^9$ spores per ml., and the other after nine serial

passages and applied at $3{\cdot}5 \times 10^9$ spores per ml. The percentage survival of the larvae was reduced from 48·8 to 39·4 by the first suspension and to 15·5 by the second, and this reduction was significant. The bacterium was isolated from all dead larvae found.

Neilson (C. L.) & Finlayson (D. G.). **Notes on the Biology of the Tuber Flea Beetle, *Epitrix tuberis* Gentner (Coleoptera: Chrysomelidae), in the Interior of British Columbia.**—*Canad. Ent.* **85** no. 1 pp. 31–32, 5 refs. Ottawa, 1953.

Epitrix tuberis Gentner was first reported as a pest of potato in the interior of British Columbia in 1944 [*cf. R.A.E.*, A **35** 43], when it was observed in the southern Okanagan Valley and at two other places in the south, but the extent and intensity of infestation have since increased [*cf.* **37** 359] and the flea-beetle has now become a serious pest over a considerable area. During observations on its bionomics, overwintered adults were first observed in the Nicola Valley and the Kamloops district on 28th May and 1st June in 1948, and the corresponding date for Kamloops in 1949 was 30th May; observations in 1950 and 1951 indicated that they appear even earlier in areas further south. The two sexes were about equal in numbers. Pairing took place within 24 hours of emergence and was repeated intermittently over an interval of 60 days. The pre-oviposition period of both overwintered and first-generation females lasted 5–8 days. Eggs were laid singly, and the number produced per female varied from 28 to 203. In 1948, first-generation adults appeared on 20th July in the Nicola Valley and there was no second generation, possibly owing to floods and exceptionally heavy rain. In 1949, first-generation adults emerged in the Kamloops area on 19th July and second-generation adults on 1st September. Males and females taken while pairing survived in cages for 24–106 and 6–60 days, respectively. Adults were observed feeding on leaves of numerous wild and cultivated plants, a list of which is given, but it is not known whether this continued after potato became available.

MacPhee (A. W.). **The Influence of Spray Programs on the Fauna of Apple Orchards in Nova Scotia. V. The predacious Thrips *Haplothrips faurei* Hood.**—*Canad. Ent.* **85** no. 1 pp. 33–40, 5 refs. Ottawa, 1953.

This fifth part of a series dealing with long-term investigations of the effects of sprays on the arthropod fauna of apple orchards in Nova Scotia, of which three parts had been published previously [*R.A.E.*, A **38** 270, etc.], is concerned with *Haplothrips faurei* Hood, which preys on the eggs of several major pests of apple and had earlier been misidentified in Canada as *H. subtilissimus* (Hal.) [**30** 586]. Evidence is presented of its ability under favourable conditions to check infestation by *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi*, auct.), *Bryobia practiosa* Koch, *Spilonota ocellana* (Schiff.) and *Cydia* (*Carpocapsa*) *pomonella* (L.). Small-scale experiments and observations in experimental and commercial orchards on the effect of various spray materials on *H. faurei* showed that DDT, parathion, and BHC almost eliminated it, sulphur caused a marked reduction in numbers, cryolite, nicotine sulphate, summer oil and the fungicides, Phygon [dichloronaphthoquinone] and Tag (10 per cent. phenyl mercury acetate), caused some reduction, and arsenicals, fixed nicotine, copper fungicides, ferbam [ferric dimethyl dithiocarbamate] and Crag Fruit Fungicide (341-C) [a commercial mixture of glyoxalidines] had no deleterious effect.

Studies on the bionomics of *H. faurei* [**38** 271], all stages of which are described, showed that the egg, nymphal and combined prepupal and pupal stages lasted for averages of 12, 15 and 6 days, respectively. The overwintered adults were active by early May and fed on eggs of *P. pilosus* while these were available, and then on the quiescent mites or the eggs of other mites. They oviposited between late May and mid-July. The eggs hatched during the latter part of June, when first-generation eggs of *P. pilosus* were being deposited, and gave rise to adults about 15th July. In 1947, adults formed 95 per cent. of the population by 1st August, and, where mites were abundant, they remained numerous until late autumn. Many of the first- and second-generation adults overwinter, but it is doubtful whether any adults of the third generation are produced in time to do so. The thrips is usually associated with *P. pilosus* and *B. praetiosa*, but the nymphs also completed their development on eggs of other mites and *S. ocellana* and have been observed attacking Cecidomyiid larvae and eggs of *C. pomonella*. Eggs are laid in spring among the hairs on the stems of the leaf-clusters and along the mid-ribs of the leaves and in late summer and autumn among eggs of *P. pilosus* at the calyx end of the apples.

Factors contributing to the effectiveness of *H. faurei* are its relatively short development period and high reproductive rate and the longevity and voraciousness of the adults. The numbers ultimately reached by it are dependent on the population of mites and other predators present and on the type of sprays applied. If conditions are favourable and the nucleus of a population exists in spring, it can control mite infestations within one season; the extent to which it migrates from neighbouring vegetation to orchards is unknown. It is unable to control *S. ocellana* and *C. pomonella* unless it has first built up on phytophagous mites. The latter are often reduced by a combined attack by *H. faurei* and predacious mites, and as infestations decrease, *H. faurei* tends also to become less numerous.

Nelson (W. A.) & Farstad (C. W.). **Biology of** *Bracon cephi* **(Gahan) (Hymenoptera: Braconidae), an important native Parasite of the Wheat Stem Sawfly,** *Cephus cinctus* **Nort. (Hymenoptera: Cephidae), in western Canada.**—*Canad. Ent.* **85** no. 3 pp. 103–107, 1 fig., 7 refs. Ottawa, 1953.

Bracon cephi (Gah.), the immature stages of which are described, is the most important parasite of *Cephus cinctus* Nort. on wheat in the Prairie Provinces of Canada, but varies in abundance in different areas. Its biology was studied in Alberta in 1943 and 1944 and in Saskatchewan in 1946 and 1947 by means of rearing experiments in field and laboratory, dissection of adult females and extensive field observations and surveys. The results showed that adults from the overwintered larvae are present during June–August and those of a partial first generation during August–September. Eggs are laid in July–August and August–September, respectively, in the wheat stems in or near the paralysed host larvae. The parasites hatch in 1–2 days and feed externally on the host for ten days, after which they construct the cylindrical cocoons in which they overwinter and pupate; under laboratory conditions, at 25°C. [77°F.] and 70 per cent. relative humidity, the prepupal and pupal stages lasted about two and six days, respectively. Males survived for about three weeks and females for up to about four, with a preoviposition period of about three weeks. The adults were most active at temperatures of 70–80°F. during sunshine following rain, and parasitism at a place in Alberta in 1943 was observed to increase from 20 to 50 per cent. within three days of rain.

Pontis Videla (R. E.). **Las virosis de la lechoza** (*Carica papaya* **L.) en Venezuela. I. Transmisión del " mosaico."** [Virus Diseases of Papaya (*C. papaya*) in Venezuela. I. Transmission of Mosaic.]—*Agron. trop.* **2** no. 4 pp. 241–251, 3 figs., 12 refs. Maracay, 1953. (With a Summary in English.)

The author reviews the virus diseases of papaya and their insect vectors [*cf. R.A.E.*, A **41** 144, etc.] and gives an account of experiments in Venezuela on the transmission of papaya mosaic, which causes serious losses in the State of Aragua. The symptoms of the disease are described [*cf.* **37** 33]. The virus was transmitted by sap and by grafting, but not through the seeds. In tests with Aphids, batches of 5–10 nymphs and adults of *Aphis spiraecola* Patch, *A. gossypii* Glov. and *Myzus persicae* (Sulz.) (taken on *Citrus*, cotton and cabbage, respectively) were starved for 30–60 minutes, allowed to feed for 15 minutes on infected papaya plants and then confined on healthy plants 6–16 ins. high. Aphids that had fed only on uninfected material were also confined on healthy plants, and other controls received no Aphids. All three species transmitted the virus, the numbers of plants infected being 4, 7 and 5 out of 8, 15 and 14, respectively, and the incubation period lasted 8–25 days, with an average of 12. All the control plants remained healthy. In a further test with *M. persicae*, batches of 50 insects that had fed on leaves from infected papaya transmitted the virus to five of ten healthy plants, and there was again no infection in the controls.

Szumkowski (W.). **Nota preliminar sobre el gusano rosado grande del algodonero,** *Sacadodes pyralis* **Dyar (Lepidoptera: Noctuidae), en Venezuela.** [A preliminary Note on *S. pyralis* on Cotton in Venezuela.] —*Agron. trop.* **2** no. 4 pp. 267–273, 4 refs. Maracay, 1953. (With a Summary in English.)

Sacadodes pyralis Dyar is an important pest of cotton in Venezuela and caused severe damage in 1952, when three generations developed in some areas before the crop matured, owing to an extended sowing period from mid-June to mid-October, and late crops showed as many as 500 eggs per 100 bolls.

In observations on its bionomics [*cf. R.A.E.*, A **15** 238], the egg, larval and prepupal stages lasted for averages of 6, 15·4 and 4 days, respectively, at an average temperature of about 25°C. [77°F.]. In September–October 1951, the pupal stage lasted 23–28 days for males and 16–19 days for females, and similar periods were recorded during most of the year, but in August 1952 one female emerged after a pupal stage lasting 147 days, and in October, a male emerged after 40 days. Further observations in 1952–53 confirmed the occurrence of diapause in the pupal stage. Some larvae collected in November 1952 gave rise to adults after a pupal stage of 17–24 days, but one male emerged after one of 50 days and three females after 47–67 days, and among examples collected on 5th December, the pupal stage lasted 16–17 days for six females, 66 days for two, and 70 days for a male, while one pupa was still alive after 160 days, when the observations were discontinued. From 32 pupae from larvae collected in January 1953, seven adults emerged after the normal period and one male after 117 days, while six pupae were still alive at the end of this period. The occurrence of the diapause explains the survival of the pest during the dry season independently of its food-plants [*cf.* **15** 239].

The length of life of the adults was 3–8 days, with averages of 4·4 and 5·7 days, respectively, for males and females. The preoviposition period

lasted 1–2 days, and the females laid an average of 38 eggs per day and an average total of 128, with corresponding maxima of 142 and 197. Unfertilised females also oviposited. The eggs were usually laid on the bracts of the green bolls, but were also observed on those of the squares and flowers, and the larvae entered the squares and bolls a few hours after hatching.

During a survey in February 1953, *S. pyralis* was found on cultivated and wild cotton throughout northern Venezuela. It has been recorded from *Hibiscus sabdariffa* and *H. esculentus* in Trinidad [**14** 47], and in 1951, eggs and larvae were found on *Cienfuegosia affinis*, which has not previously been recorded as a food-plant. Subsequent investigations showed that eggs were often present on the bracts and larvae in the bolls and flowers of this plant after the cotton had matured. Several natural enemies of this pest have been reported [**26** 403, etc.]. In Venezuela a species of *Polistes* was predacious on the larvae in the field, and *Ceratomegilla* (*Coleomegilla*) *maculata* (Deg.) and *Cycloneda sanguinea* (L.) attacked them in the laboratory. In January 1952, *Apanteles thurberiae* Mues. parasitised 14–20 per cent. of the larvae in one area.

The methods of control recommended include field sanitation and the early destruction of old cotton plants, to prevent the formation of diapausing pupae, and of abandoned and wild cotton, on which the pest develops early in the season. Deep ploughing may destroy many pupae in the soil. Cotton should be sown over as short a period as possible, to prevent the excessive damage caused to late crops, and quick-growing varieties are preferred; early sowing might prove beneficial. Eggs should be destroyed early in the season, and if they are numerous, insecticides applied as soon as the larvae hatch, but treatment is not advisable if the early eggs are well scattered, owing to the danger to natural enemies.

YATES (J.). *Haplothrips niger* **Osb., the Red Clover Thrips.**—*N.Z. J. Sci. Tech.* **34** (B) no. 3 pp. 166–172, 7 figs., 5 refs. Wellington, N.Z., 1952.

Thrips, which are normally present in small numbers on red clover (*Trifolium pratense*) grown for seed in New Zealand, become abundant in some years, and these outbreaks have been thought to be associated with increased percentages of shrivelled seeds among the harvested crop. Since *Haplothrips niger* (Osb.) [*cf. R.A.E.*, A **22** 41], all stages of which are described, is the commonest species, studies were made on its bionomics and effect on yield in two districts in the north-east of the South Island during 1950–52. It occurs most commonly on red clover, but is fairly numerous on white clover [*T. repens*] and was also found on strawberry clover [*T. fragiferum*] and lucerne. Parthenogenesis was normal, males being rare, and there was one generation and a partial second each year. The full-fed nymphs overwintered in hollow clover stalks near the ground, and pupae were present under the stipules of the growing plants from the end of October until the end of November. The adults emerged after a combined prepupal and pupal period of some 27 days and were present on the crop from the end of November until February, though they were common on self-sown red and white clover from mid-October. They congregated on the flower heads, and oviposition began when the flowers were almost fully open, each female laying 1–2 eggs per day for several weeks on the hairs of the calyces. The nymphs fed within the corolla tube or congregated between the young seed pods, and pupated in January, the egg, nymphal and combined prepupal and pupal stages of this generation lasting 12, about 28 and 11 days, respectively. The resulting adults oviposited between January and mid-March, when the seed is harvested. Their eggs hatched in a minimum of three days and nymphs rapidly became fully

grown; as the seed heads dried, they moved down the stems and were close to the ground, where they overwintered, at harvest, so escaping injury. Second-instar nymphs collected on 10th January completed their development without interruption, but first-instar nymphs entered diapause and did not give rise to adults till the following spring. Eggs, nymphs and adults of another species tentatively identified as *Nesothrips* (*Oedemothrips*) *propinquus* (Bagn.) were common in hollow clover stalks during May–September.

According to K. M. Doull, adult feeding may damage the floral tissues enough to interfere with fertilisation, so reducing the amount of seed set, and modify the seed so that it readily absorbs water, thus reducing the percentage of hard seed. Feeding by the nymphs on the green seed pods causes the developing seeds to shrivel. In an insectary test to determine the effect of feeding on yield, in which 200 adults or 200 nymphs per head were caged on the flower heads of red clover in pots after provision had been made for pollination, about 45 per cent. of the harvested seeds were shrivelled. In the field, infestation approximated to 20 adults or 30 nymphs per head in each season, and was below the average in newly sown stands. Of the seeds from an established stand on light well-drained soil where overwintering populations were high and there were about 40 adults or 50 nymphs per head, nearly 25 per cent. were shrivelled, whereas shrivelled seeds comprised less than 3 per cent. of the crop from a stand of the same age on soil that was waterlogged and unfavourable for the overwintering nymphs and in which many flower heads were uninfested and few contained more than five adults or nymphs.

Clark (L. R.). **The Ecology of** *Chrysomela gemellata* **Rossi and** *C. hyperici* **Forst., and their Effect on St. John's Wort in the Bright District, Victoria.**—*Aust. J. Zool.* **1** no. 1 pp. 1–69, 3 pls., 3 graphs, 13 refs. Melbourne, 1953.

An account is given of investigations in 1948–51 on the effectiveness of the introduced *Chrysomela quadrigemina* Suffr. (*gemellata* Rossi) and *C. hyperici* Forst. in controlling the noxious weed, *Hypericum perforatum* var. *angustifolium* in the Ovens Valley, near Bright, Victoria, where these beetles were first liberated, and the factors influencing it. The studies were made in areas representative of the three principal classes of habitat in which *Hypericum* is the dominant herbaceous plant and in experimental type sites providing conditions closely resembling them that were set up at Bright. The aspects studied were the seasonal cycle and general behaviour, the fecundity of the females and fertility of the eggs, the factors affecting egg development, the causes of mortality at different stages of development, and the effect of the insects on the plant. The methods used for separating the eggs and larvae of the two species and for estimating variance in survival rates and adult numbers are described. Detailed descriptions of methods for estimating the numbers of eggs present in the field and the numbers of eggs of each species present in a mixed sample are given by G. A. McIntyre in two appendices (pp. 63–69).

The following is largely taken from the author's summary of the results. The investigation showed that the conditions prevailing in the Bright district during the study period must have been generally near the limit of tolerance of both *C. quadrigemina* and *C. hyperici*, parts being a little above and parts definitely below this limit [*cf.* also *R.A.E.*, A **42** 73]. Furthermore, largely because of behaviour responses causing the adults, especially those of *C. quadrigemina*, to avoid remaining in timbered areas, neither insect has been

able permanently to colonise *Hypericum* in such areas. The most favourable habitats comprised treeless areas with much ground cover provided by *Hypericum* or densely growing perennial grasses, but the total area favouring the multiplication of the insects formed only a small part of that colonised by *Hypericum*. Within the favourable zone, the beetles have failed to control *Hypericum* effectively except in small, treeless areas adjoining densely timbered country infested by the weed, where the timbered area has reduced population fluctuations and thus enabled the insects to persist in moderate numbers.

Both species have poor powers of dispersal and a relatively poor reproductive ability. In the most favourable sites, both multiply within a few years to a density high enough to cause complete defoliation of the food-plant, which usually dies out. By destroying their food and reducing the cover protecting them against frost and predators, both species suffer very heavy losses. After completely defoliating the weed, the surviving beetles migrate elsewhere in search of food. Their desertion of the site allows the plant to regenerate from seed and the plant population frequently recovers almost completely before beetle numbers become high enough to cause defoliation. Where other controlling agencies are lacking, the insects have caused the density of *Hypericum* to fluctuate violently in both space and time without producing a great overall reduction in quantity. By destroying stands of *Hypericum* in areas in which the soils are capable of supporting a dense pasture, they have paved the way for successful control by factors such as shade-producing herbage and grazing animals. Such areas virtually cease to provide habitats for the insects after the original stand of *Hypericum* is destroyed.

Clark (L. R.). **An Analysis of the Outbreaks of the Australian Plague Locust, *Chortoicetes terminifera* (Walker), during the Seasons 1940–41 to 1944–45.**—*Aust. J. Zool.* **1** no. 1 pp. 70–101, 22 figs., 5 refs. Melbourne, 1953.

Analyses of outbreaks of *Chortoicetes terminifera* (Wlk.) [*cf. R.A.E.*, A **30** 420; **31** 422] were continued in New South Wales and Queensland during 1940–45 and the following is almost entirely the author's summary of the findings. Outbreaks occurred each summer during the period, but the largest, that of 1942–43, was less severe than those recorded in 1937–38, 1938–39 and 1939–40. Consideration of the course of the recent outbreaks in relation to temperature and moisture again demonstrated the importance of these factors in determining the regional and seasonal occurrence of swarms. The curve of limiting conditions for the persistence of swarm populations obtained by Key [**30** 421] was a useful guide for the interpretation of events, though a number of discrepancies occurred. These were due probably to a variety of causes, such as the type and size of the swarms concerned, the crudeness of the monthly Meyer ratio [**29** 141] as an index of soil moisture and pasture conditions, and regional differences in the upper moisture limits at high temperatures. The results suggested that the minimum Meyer ratios for the persistence or development of a spring infestation of small, weakly gregarious swarms at temperatures between 60 and 70°F. exceed 4–5 if the September Meyer ratio is 5 or less or if the spring is preceded by a severe winter drought; that at temperatures of about 75°F., the maximum Meyer ratio at which swarms can exist is approximately 20; and that at temperatures near the estimated hatching threshold of 57·5°F., swarm hatching can occur at Meyer ratios as low as 4–5. The collapse of the 1942–43 outbreak in part of the main area infested was due

apparently to parasitism of the locusts by an unidentified Sarcophagid or Tachinid. Similarly, a biotic factor, possibly the same parasite, was largely responsible for the decline of the 1943–44 outbreak during the late spring and early summer.

GAY (F. J.). **Observations on the Biology of** *Lyctus brunneus* **(Steph.).**—*Aust. J. Zool.* **1** no. 1 pp. 102–110, 3 refs. Melbourne, 1953.

Many of the native timbers now used in Australia possess a wide sapwood and are therefore susceptible to attack by *Lyctus*. The main species concerned is the introduced *L. brunneus* (Steph.), and observations on its bionomics in Australian timbers were carried out with a view to control. The following is partly based on the author's summary of the results.

The females oviposited within 24 hours of emerging from infested timber and laid an average of more than 70 eggs each over a period of 1–2 weeks; more eggs were usually laid during the first 24 hours than on any subsequent day. Eggs were deposited at depths of 1–6·5 mm. in the wood vessels, preferably through a transverse surface, but also through radial and tangential faces. The duration of the egg stage ranged from about a week at 26°C. [78·8°F.] to three weeks at 15°C. [59°F.], and that of development from egg to adult from four months at 26°C. to 15 months or more at 15°C. Under optimal conditions of nutrition, temperature, relative humidity and hence moisture content of the wood, the life-cycle was completed in as little as two months in some cases. In three highly susceptible timbers, *Schizomeria ovata*, *Alstonia scholaris* and *Sterculia acerifolia*, kept at 26°C. and 75 per cent. relative humidity, development was completed in average minimum periods of 146, 92 and 75·5 days, respectively. The two sexes were equal in numbers, and the adults survived for 2½–7 weeks, depending on temperature, females living somewhat longer than males.

The temperature and exposure period necessary to ensure an effective kill of the eggs and larvae by heat treatment were determined in tests in which small blocks cut from sapwood of *A. scholaris* were exposed to pairs of adults for 24 hours and cut in two immediately or, for experiments with the larvae, after incubation for three weeks at 26°C., after which one half of each block was returned immediately to that temperature and the other after treatment at various temperatures and exposure periods in a constant-temperature container submerged in a water bath. The larvae were found to be rather more resistant than the eggs, but exposure to 50°C. [122°F.] for half an hour gave complete mortality of both stages.

JENKINS (C. F. H.) & SHEDLEY (D. G.). **Insect Pests and their Control. The Citrus White Fly** (*Aleuroplatus citri* **Tak.**).—*J. Dep. Agric. W. Aust.* (3) **2** no. 1 pp. 49–51, 53, 55, 5 figs., 2 refs. Perth, W. A., 1953.

Aleuroplatus citri Takah., an Aleurodid that was described from New South Wales [*R.A.E.*, A **29** 88], where it is of little importance, was recorded in 1950 for the first time in Western Australia, where it attacked lemon and was subsequently found to be widely distributed in several areas; at about the same time it appeared in *Citrus* orchards in north-western Victoria. It passes through several generations a year, and all stages are usually present together, though eggs and adults are not numerous in winter. Infestation is heaviest during spring and autumn, when young growth is most plentiful. The eggs are laid on the lower surface of the leaves, and all varieties of *Citrus* are attacked, though lemon is preferred.

The trees are weakened by the feeding of the adults and larvae, but the main damage consists in the production of copious honeydew, which favours the growth of sooty mould on fruits, leaves and branches.

In Victoria, a spray of 1½ gals. white oil and 1 pint nicotine sulphate in 60 gals. water applied in spring, when infestation first appears, and again, if necessary, 2–3 weeks later, has given good control; hexaethyl tetraphosphate or parathion can be substituted, provided that they are not applied within a month of harvest. DDT is also effective and can be used for small or restricted outbreaks, but is not recommended for large-scale application owing to the risk of killing the natural enemies of Coccids. Since fungi may afford some control, it is suggested that fungicides should not be applied to the top third of each tree, so that any beneficial fungi may be able to recolonise the lower parts. Slight control is given by Coccinellids and Chrysopid larvae, and larvae of *Clambus* sp. were observed preying on the eggs.

Schreier (O.). **Über das Auftreten von Blattläusen an Kartoffelstauden in Niederösterreich im Jahre 1952.** [On the Occurrence of Aphids on Potato in Lower Austria in 1952.]—*Pflanzenschutzberichte* **10** pt. 9–10 pp. 129–153, 6 figs., 24 refs. Vienna, 1953. (With a Summary in English.)

Observations to determine suitable areas for the raising of virus-free seed potatoes in Austria [*cf. R.A.E.*, A **41** 44] were continued in the summer of 1952, when counts of Aphids were made on potato crops grown in three districts of Lower Austria and flight was investigated by means of trap boards covered with adhesive and painted yellow. The field counts showed that *Aphis* (*Doralis*) *rhamni* Boy. was generally the most numerous species present, though *Myzus* (*Myzodes*) *persicae* (Sulz.) predominated in exceptional cases. Infestation reached its peak in July or August, and varied with locality, variety of potato and time of planting. Density was not related to the position of the leaves on the stalk. Virus transmission is affected more by the distribution of alates than by the number of apterae present, but the average number of Aphids per leaf and the percentage of leaves infested generally increased together and the former was therefore a valid measure of the danger of infection. The trap boards were set to face each of the four cardinal points. The numbers of Aphids taken were highest for those facing south and about equal for the others. Since south winds did not prevail, it is concluded that Aphid flight is active rather than passive.

The effect of meteorological conditions on infestation and the suitability of the districts for raising seed potatoes are discussed. Two areas appeared suitable.

Böhm (O.). *Psalidium maxillosum* **F. als Weinschädling in Österreich.** [*P. maxillosum* as a Pest of Vines in Austria.]—*Pflanzenschutzberichte* **11** pt. 3–4 pp. 45–46, 3 refs. Vienna, 1953. (With a Summary in English.)

In view of serious injury to the leaves of grape vines by *Psalidium maxillosum* (F.) at a place in Lower Austria in 1953, the literature on the food-plants, bionomics and control of this weevil in south-eastern Europe [*cf. R.A.E.*, A **31** 224; **36** 62] is briefly reviewed, and previous records of it in Austria are summarised. It was taken there on tobacco in 1944.

Mühle (E.). **Die Krankheiten und Schädlinge der zur Samengewinnung angebauten Futtergräser. Erhebungen, Beobachtungen und Untersuchungen über ihr Auftreten, ihre Biologie und Bekämpfung.** [The Diseases and Pests of Fodder Grasses grown for Seed. Findings, Observations and Investigations on their Occurrence, Bionomics, and Control.]—*Wiss. Abh. dtsch. Akad. Landw. Berlin* **1,** 9½ × 7 ins., viii + 167 pp., 36 figs., 429 refs. Leipzig, S. Hirzel Verlag, 1953. Price *DM.* 8.80.

Investigations on the pests and diseases of fodder grasses grown for seed in Germany were begun in 1939 and were still in progress at the date of publication of this book. Some 14 grasses are included, and the results are presented in detail and supplemented with information from the literature. After an introductory discussion of the importance of the subject, there are two main sections, one on pests and diseases of general significance affecting the grasses at different stages of development, and the other on those attacking the individual species. Most of the pests are insects, and information is given on their bionomics and economic importance.

Blunck (H.). Ed. **Tierische Schädlinge an Nutzpflanzen. 2. Teil.** [Animal Pests of Economic Plants. Part 2.]—Sorauer (P.). *Handb. Pflanzenkr.* **5,** 5. Aufl., 2. Lief., [6+] 599 pp., 161 figs., many refs. Berlin, P. Parey, 1954. Price *DM.* 144.

This is the second part of the greatly enlarged fifth edition of the fifth volume of Sorauer's textbook [*cf. R.A.E.*, A **41** 333] and comprises the section on Coleoptera [*cf.* **17** 256], to which 13 authors have contributed.

Voevodin (A. V.). **Combined Application of Herbicides and Insecticides in the Treatment of Cereal Crops.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **18** no. 9 pp. 33–35, 4 refs. Moscow, 1953.

In tests on the combined application of insecticides and herbicides to wheat in the region of Krasnodar in 1952, a dust containing 12 per cent. BHC, against larvae of *Lema melanopa* (L.), was applied from an aeroplane in May at 9 lb. per acre in combination with 2,4-D [dichlorophenoxyacetic acid] at about 2·7 lb. per acre against field mustard (*Sinapis arvensis*). The results showed that mortality of *Lema* was almost complete in five days and complete in ten, but that action against the weed was too slow for practical effectiveness. When the two materials were applied in a spray at the same rates in June, mortality of *Lema* was just as high and that of the weed much improved. In further tests, BHC also proved compatible with colloidal sulphur against fungus disease, with or without the addition of 2,4-D.

Suomalainen (E.). **Neueres über das Vorkommen der Nonne,** *Lymantria monacha* **L. (Lep., Lymantriidae) in Finnland.** [Further Information on the Occurrence of *L. monacha* in Finland.]—*Ann. ent. fenn.* **19** no. 2 pp. 52–56, 1 map, 1 ref. Helsinki, 1953.

Lymantria monacha (L.) occurs only on the south coast and is normally rare in Finland, but appeared to be more numerous than usual in 1951 and 1952, when adults were taken, chiefly at night, in various localities, which are shown on a map. This may have resulted partly from the

introduction of mercury lamps, but the numbers also observed at street lamps indicated that there had been a real increase, which was probably connected with recent outbreaks in southern Sweden.

Mühlow (J.) & Sylvén (E.). **Oljeväxternas skadedjur.** [The Pests of Oil-seed Plants.]—163 pp., 8 col. pls., 50 figs., refs. Stockholm, Natur och Kultur, 1953. Price bound *Kr.* 19.50; unbound *Kr.* 16.50.

In this booklet, the authors review methods of controlling insect pests of crop plants and protecting bees and other beneficial species from injury by insecticides, describe the cultivation of oil-seed plants in Sweden, and give notes on the bionomics, economic importance and control of the insects that attack them there. The plants considered are various crucifers (chiefly rape and turnip rape), poppy (*Papaver somniferum*) and flax.

Papers noticed by Title only.

Brimblecombe (A. R.) & Cannon (R. C.). **The Protection of stored Potatoes against the Potato Tuber Moth,** *Gnorimoschema operculella* **Zell. Part 1. Trials in southern Queensland. Part 2. Trials in northern Queensland.**—*Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 48, [10 pp.] 1 ref. Brisbane, 1949. [See *R.A.E.*, A **38** 389.]

Brimblecombe (A. R.). **The Prevention of Borer Attacks on Hoop Pine** [*Araucaria cunninghami*] **Logs** [in Queensland].—*Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 52, 37 pp., 13 figs., 13 refs. Brisbane, 1952. [See *R.A.E.*, A **41** 407.]

May (A. W. S.). **The Cotton Jassid** [*Austroasca terrae-reginae* (Paoli)] **Problem in Queensland.**—*Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 55 (1950), 19 pp., 3 figs., 17 refs. Brisbane, 1951. [See *R.A.E.*, A **39** 258.]

May (A. W. S.). **Jassid Resistance of the Cotton Plant** [to *Austroasca terrae-reginae* (Paoli) in Queensland].—*Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 58, 26 pp., 10 figs., 24 refs. Brisbane, 1952. [See *R.A.E.*, A **41** 406.]

Jacks (H.). **Soil Disinfection. XIII: An Injector for Field Fumigation.**—*N.Z. J. Sci. Tech.* **34** (B) no. 3 pp. 139–145, 7 figs., 4 refs. Wellington, N.Z., 1952.

Burr (M.). **The Insect Legion.**—2nd edn., $8\frac{3}{4} \times 5\frac{1}{2}$ ins., xvi + 336 pp., 15 pls., 5 figs. London, J. Nisbet & Co. Ltd., 1954. Price £1 1*s*. [*Cf. R.A.E.*, A **27** 455.]

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